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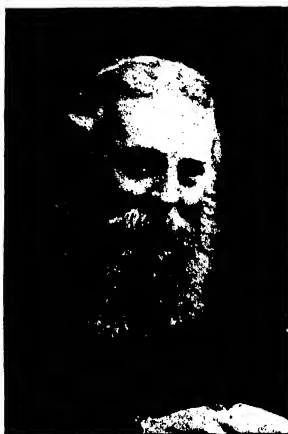


THE NEW  
POPULAR ENCYCLOPEDIA

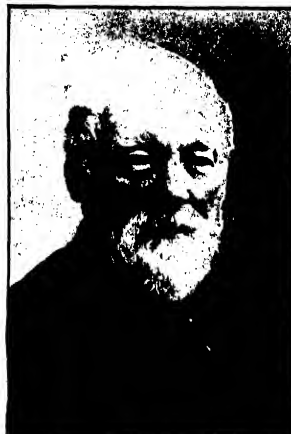
PORTRAITS OF MEN OF THE TIME.—XIII.



F. C. Selous



Rev. W. W. Skeat



Samuel Smiles



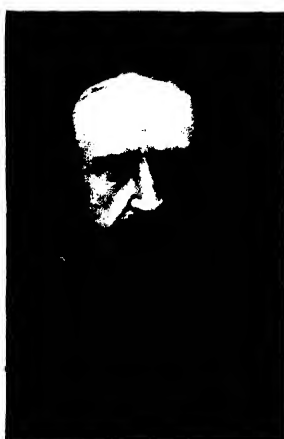
Herbert Spencer



Rev. C. H. Spurgeon



Sir H. M. Stanley



Sir Leslie Stephen



R. L. Stevenson



A. C. Swinburne

\*.\* The portraits, with the exception of R. L. Stevenson, are from photographs by Messrs. Elliott & Fry.





# The New Popular Encyclopedia

A General Dictionary of the  
Arts and Sciences, Literature  
Biography, History, Geography  
&c.

A New and Revised Edition of the Popular Encyclopedia

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Issued under the General Editorship of

CHARLES ANNANDALE, M.A., LL.D.

Editor of Ogilvie's "Imperial Dictionary"

Assisted by

MANY SPECIALISTS

IN

THE VARIOUS BRANCHES OF HUMAN KNOWLEDGE

Volume XIII

THE GRESHAM PUBLISHING COMPANY  
LONDON AND GLASGOW  
1903



# LIST OF PLATES AND MAPS.

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# SELECT PRONOUNCING LIST

## OF ENTRIES IN VOL. XIII.

KEY: **f** as in fate or in fare, **ä** as in far (sometimes short, sometimes long), **a** as in fat, **g** as in fall; **ë** as in me, **e** as in met, **é** as in her; **i** as in pine, **ï** as in pin; **ô** as in note, **o** as in not, **ö** as in move; **û** as in tube, **u** as in tub, **ü** as in bull; **ü**, the French **u** (sometimes short, sometimes long); **ou** as in pound; **ch** as in chain; **h** as in Scotch loch, German nach; **n** as in French ton; **th** as in thin; **th** as in this; **w** and **y** always consonants; **zh** as **z** in azure or **j** in French jaune.

Seleucidæ, se-lû'äi-dê  
Selous, se-lô  
Semele, sem'e-lê  
Seminoleæ, sem'ä-nôlz  
Semiramis, se-mi'ra-mis  
Semiretchenak, se-mi-re-  
chenak  
Semtito, se-mit'ik  
Semnophthecus, sem-nô-pi-  
thê'kus  
Semolina, se-mo-lî'na  
Sempach, zem'pât  
Seneca, sen'e-ka  
Senegal, sen'e-gâl  
Seneschal, sen'e-shal  
Senlis, sän-läs  
Mennaar, sen-är'  
Sennacherib, sen-nak'e-rib  
Senones, sen'o-nöz  
Sena, sänz  
Seoul, sé-ül'  
Sepia, sé'pi-a  
Septuagesima, sep-tû-a-jes'i-  
ma  
Septuagint, sep-tû-a-jint  
Sepulveda, sä-pül'vä-dä  
Sequoia, se-kwoi'a  
Seraglio, se-ra'l'yô  
Seraing, sé-rañ  
Serajevo, se-rä-yä'vô  
Serampore, se-ram-pôr'  
Serapeum, se-rä-pé'um  
Serapion, se-rä'pi-on  
Serapis, se-rä'pis  
Scrapsier, se-ras'kër  
Serena, se-rä'nä  
Seres, sä'res  
Sereth, se-ret'  
Sergipe, ser-zhê'pä  
Seriema, se-ri-é'ma  
Seringapatam, se-ring-a-pa-  
tam  
Scriphos, se-rê'fos  
Serpukhov, ser'py-hof  
Serpula, ser'pû-la  
Serranus, ser-rä'nus  
Sertorius, ser-tô-ri-us  
Sertularia, ser-tû-lä-ri-a  
Servetus, ser-vé'tus  
Sesame, ses'a-mê  
Sesamum, ses'a-mum  
Sesostria, se-sos'tria  
Sestetto, ses-tet'to  
Setif, se-tif'  
Setubal, se-tô'bal  
Sevastopol, se-väs-tô'pol  
Severo, se-vä'rô  
Severus, se-vê'rus  
Sévigne, sä-vên-yä  
Sevilla, Sp. Sevilla; se-vil',  
se-vêl'yä  
Sèvre, sävr  
Sèvres, sävr  
Sèvres, Deux, dé sävr  
Sewage, sü'ärd  
Seward, sü'ärd  
Sewell, se-wel'el  
Sextus Empiricus, em-pi'ri-  
kus  
Seychelles, sä-shel'  
Seymour, sä'mor  
Seyne, sän  
Sforza, sfôr'tä  
Shaftesbury, shäfts-be-ri  
Shagreen, sha-grên'  
Shahjehanpur, shä-je-hän'-  
pôr

Shairp, shärp  
Shakspere, Shakespeare, &c.,  
shäk'spêr  
Shallot, sha-lôt'  
Shamanism, shä'man-izm  
Shamyl, sham'il  
Shanghai, shang-hä'  
Shapinsay, shap'in-shä  
Sheboygan, shê-hôf'gan  
Shechinah, shê-kî'nä  
Sheik, shêk or shäk  
Shell, shel  
Shekel, shêk'el  
Shemakha, shê-mä-hä'  
Shenandoah, shen-an-dô'ä  
Shense, shen-sê  
Sheriff, shê-rif  
Shiltes, shî'ts  
Shikarpur, shik-är-pôr'  
Shikoku, shi-kô'kü  
Shiloh, shî'lô  
Shimoga, shi-mô'gi  
Shimonoseki, shi-mô-nô-sek'i  
Shiraz, shi-räz'  
Shiré, shê'rä  
Sholapur, shô-la-pôr'  
Shoshone, shô-shô-nê'  
Shoshong, sho-shong'  
Shrewsbury, shröz-be-ri  
Shujabad, shô-ja-bäd'  
Shuaha, shô-shü'  
Shuster, shüs'têr  
Siam, si-ani'  
Sikasagar, sêb-sä'gar  
Sibyl, sih'il  
Sicard, së-kär  
Sickingen, sik'ing-en  
Sicyon, si'i-on  
Siebenbürgen, zê-ben-bür-gen  
Siebengebirge, zê-ben-ge-bir-  
ge  
Siedlee, eyed'täe  
Siegen, zê-gen  
Siemens, së'menz or zê'menz  
Sienna, si-ä'nä  
Sienna, si-en'nä  
Sieradz, syä'rädz  
Sierra Leone, si-er'rä lê-ô'nê  
Sierra Morena, si-er'rä mô-  
rä'nä  
Sierra Nevada, si-er'rä ne-  
väd'ä  
Sieyès, së-yäs  
Sigillaria, sij-il-lä-ri-a  
Sigismund, sij-lä-mund; Ger.  
pron. zê'gis-munt  
Signorelli, sên-yô-rel'lê  
Sigourney, sig'ur-ni  
Siguenza, si-gu-en'thä  
Sikhs, siks  
Sikino, sik'i-nô  
Silchar, sil-chär'  
Silene, si-lê'nê  
Silenus, si-lê'nus  
Silesia, si-lê'si-a  
Silhet, Sylhet, sil-het'  
Silhouette, sil-yet'  
Silica, sil'i-ka  
Siliatris, si-lis'tri-a  
Siliures, si-lû-rêz  
Simbrak, sim-birak'  
Simcon, sim'é-on  
Simferopol, sim-fe-rô'pol  
Simoda, si-mô'dä  
Simola, sim'o-lä  
Simon (Julia), së-môn

Simonides, si-mon'i-dêz  
Simonoseki, si-mon-o-sek'i  
Simoom, si-nôm'  
Simplon, sah-plôn'  
Sinal, si'nä  
Sinaloa, së-nä-lô'ä  
Sinclair, sing'klêr  
Si-ngan-too, së-ngan-tô'  
Sinigaglia, së-nê-gäl'yä  
Sinope, si-nô'pê  
Sion, së-ôn  
Siout, së-öt'  
Sioux, së  
Siphonophora, si-fon-of-o-ra  
Sipunculus, si-pung-kû-lus  
Siraganj, si-rai-ganj'  
Sirenla, si-rê-ni-a  
Sirohi, si-rô'hi  
Sirsa, sir-sä'  
Sisal, si-sai'  
Sismondi, sis-mon'dê  
Sistova, sis'tô-vä  
Sisyphus, sis'i-fus  
Sitapur, si-tä'pôr  
Sivas, së-väs'  
Sivatherium, si-va-the'ri-um  
Skeat, skêt  
Skiathos, skê'a-thos  
Skibbereen, skib-e-rên'  
Skien, skê'en  
Skopelos, skop'e-las  
Skua, skü'a  
Sleaford, slê'ford  
Sliven, slê'ven  
Sligo, slî'gô  
Slough, slou  
Smethwick, smeth'ik  
Smilacæ, smi-lä'sê-ê  
Smolenak, smo-lenak'  
Sneehatten, snä'hat-n  
Sneek, snäk  
Socinus, sö-si'nus  
Socorro, sö-kor'rô  
Socotra, sö-kô'tra  
Socrates, sok-ra-têz  
Sodoma, sod'o-mä  
Soest, zöst  
Sofala, sö-fä'lä  
Sofia, sö-fi-a  
Sognefjord, sog'ne-fyord  
Sohar, sö-här'  
Soignies, söi-nyê  
Solisana, swä-sön  
Sokoto, sok'o-tô  
Solanaceæ, sö-la-nä'sê-ê  
Solanine, sö-la-nin  
Solenhofen, zô'lên-hô-fn  
Solent, sö'lent  
Solesmes, sö-läm  
Soleure, sö-lêr (long)  
Solfatara, sol-fä-tä'rä  
Solfeggj, sol-fed'jê  
Solferino, sol-fe-rê'nô  
Soldungula, sö-lid-ung'gü-lä  
Solingen, zô'ling-en  
Solothurn, sö'lô-türn  
Solyman, sol-i-män'  
Sombreterre, som-bre-rä'tä  
Sombbrero, som-brä'rô  
Somers, sum'êrz  
Somerville, sum'êr-vil  
Somme, som  
Sonnath, som-nät'  
Sonata, sö-nä'tä  
Sonderburg, zôn'dêr-bürk  
Sonderhausen, zôn'dêr-  
hou-zn

Sonneberg, zôn'nê-berk  
Sonnenburg, zôn'en-bürk  
Sonora, sö-nô'rä  
Sonsonata, son-so-nä'tä  
Sophocles, sof-o-klêz  
Soracte, so-rak'tê  
Sorata, sö-rä'tä  
Sorau, zô'rou  
Sorbonne, sor-bon  
Sorel, sö-rel'  
Soresina, sö-re-sê'nä  
Sorghum, sor'gum  
Soria, sö-re-ä  
Sotteville-les-Rouen, sot-vêl-  
lä-rô-an  
Soubise, sö-bêz  
Soudan, sö-dän'  
Soul, së-ül'  
Soulé, söl't  
Soumy, sö'mê  
Sourabaya, sö-rä-bi'ä  
Sourakarta, sö-rä-kär'tä  
Soutane, sö-tän  
Southey, sou'thi  
Southwark, south'ärk  
Souvestre, sö-ves-tr  
Spa, spä  
Spagnoletto, spä-n-yô-let'tô  
Spagnuolo, spä-n-yü-ô'lô  
Spalatro, Spalato, spä'lä-trô,  
spä'lä-tô  
Spallanzani, spä-län-tä'nê  
Spandau, spä'n'dou  
Spartacus, spä'r'ta-kus  
Spathæ, späth  
Spener, spä'nêr  
Spermaceti, spä'r-mä-sê-ti  
Spey, spä  
Speyer, spä'r  
Spezia, spä'tä-ä  
Spezzia, spä'tä-ä  
Sphagnum, sfag'num  
Spheue, sfên  
Sphygmograph, sfîg'mô-graf  
Spiegelstein, spä'gî-l-zn  
Spinage, spin'jê  
Spinelle, spi-nel'  
Spinola, spä'no-lä  
Spinosa, spä-nô'zä  
Spirea, spi-rê-a  
Spirea, spirz  
Spirula, spir'û-lä  
Spithead, spit-hed'  
Spitzbergen, spits-be'r-gen  
Spitügen, spi'tu-gen  
Spohn, spôr  
Spokane, spä-kän'  
Spoleto, spä-lä'tô  
Spondylus, spon'di-lus  
Sporades, spä'rä-dêz  
Spottiswoode, spot'is-wud or  
spots'  
Spree, sprä  
Sprottau, sprôt'ou  
Spurgeon, spur'jin  
Spurzheim, spurts'him  
Squamata, skwa-mä'tä  
Squeteague, skwe-têg'  
Srinagar, arê-na-gar  
Saumas, sä-mä'ô  
Staccato, stak-kä'tô  
Stade, stä'dê  
Stahl-Holstein, stä'el-hol'stin  
Stahl, stäl  
Stahr, stär  
Stalimene, stä-lim'e-nä  
Stalislau, stän-lä-lou

unovol, stá'no-voí  
 phyloma, staf-i-ló'ma  
 safurt, stá'fúrt  
 ubbach, stóub'bák  
 vanger, stá-váng'ér  
 ivoren, stá'vo-ren  
 ivropol, stáiv-ró'poi  
 sarine, sté'a-rin  
 sáite, sté'a-tít  
 sen, stán  
 senkerque, stán'kerk  
 siermark, stí'ér-márk  
 sin, stín  
 sinbock, stín'bók  
 sphen, sté'vn  
 sphenson, sté-vn-sun  
 srne, stórn  
 saichorus, sté-sik'o-rus  
 sthoscope, steth'o-skóp  
 stfin, stét-én'  
 suben, stó'ben  
 subenville, stú'ben-vil  
 eyer, stí'ér  
 igmata, stig'ma-ta  
 ilicho, stí'i-kó  
 omata, stó'ma-ta  
 onehaven, stóu-há'vn  
 onehenge, stón-henj'  
 othard, stó'thèrd  
 ourbridge, stur'brij  
 owe, stó  
 rabane, stra-bàn'  
 radivari, strá-di-vá're

Stralsund, strál'sunt  
 Stranraer, stran-rár'  
 Strasburg, strás'burá  
 Strathaven, strath-á'vn or  
 strá'vn  
 Straubing, strou'bing  
 Strauss, strous  
 Strepsiptera, strep-síp'te-ra  
 Strepsirhina, strep-sí-rí'na  
 Striegau, stré'gou  
 Stromboli, strom'bo-lé  
 Strophanthin, strof-an'thín  
 Strophe, stró'fē  
 Stroud, stroud  
 Struensee, strú'en-zá  
 Stry, stró  
 Strychnine, strik'nín  
 Stucco, stuk'kó  
 Stuhlweissenburg, stól'vis-  
 en-byrk  
 Sturluson, stúr'lý-son  
 Stuttgart, stú't'gúrt  
 Stylites, stí'lítis  
 Styria, stí'rí-a  
 Suaheli, swá-há'lé  
 Suakin, sú-k'kén  
 Suares, sú-á'res  
 Subiaco, sú-bí-á'kó  
 Suchet, sú-shá  
 Sucre, só'krá  
 Sudetengebirge, sú'dá-tén-ge-  
 bir-gé  
 Sue, sú

Sueca, sú-á'ká  
 Suevi, sú-é'vi  
 Sues, sú-és  
 Suffolk, suf'ók  
 Suhl, sól  
 Suida, sú'i-das  
 Suir, súr  
 Suliman, só-lí-mán'  
 Sulina, sú-lé'ná  
 Sully (Duke of), stú-lé  
 Suimona, súi-mó'ná  
 Sultanpur, súl-tán-púr'  
 Sulu, sú-ló  
 Sumach, sú'mak  
 Sumatra, sú-má'tra  
 Sumbawa, súm-bá'wá  
 Sunart, sú'nárt  
 Surabaya, só-rá-bý'a  
 Surajah Dowlah, sú-rá'já  
 dou'lá  
 Surat, sú-rat'  
 Susquehanna, sú-kwé-han'-  
 na  
 Sutherland, súth'er-land  
 Suttée, sú-té  
 Suwarof, sú-vo'rof  
 Swakopmund, swá'kop-mýnt  
 Swansea, swon'sé  
 Swatow, swá-tou'  
 Sweaborg, swá'a-borg  
 Swinemünde, swé'né-mún-dé  
 Sybaris, síb'a-ris  
 Sycamore, sí'ka-mór

Sydenham, síd'n-am  
 Syene, sí-é'né  
 Syenite, sí'en-ít  
 Syllogism, síl'o-jizm  
 Sylvester, síl'ves-tér  
 Symmachus, sím'a-ku  
 Symonds, sím'onds  
 Syncope, sín'ko-pé  
 Synecdoche, sí-nek-dó-ké  
 Synthesis, sín'the-sis  
 Syphilis, síf'i-lis  
 Syracuse, sí'ra-kúz  
 Syrtes, sér'téz  
 Syzygy, síz'i-ji  
 Szarvas, szár'vásh  
 Szathmar, szát'már  
 Szechuen, sé'chý-en  
 Szegeidin, ség'e-dén  
 Szentes, sen'tá  
 Szexard, sek'sárd  
 Szigeth, sí'get  
 Szolnok, sol'nok

## T

Taaasinge, tó'sing-é  
 Tabasheer, tab'a-shēr  
 Tableaux Vivants, táb-ló vó-  
 vâh  
 Tabreez, tab-réz'

# THE NEW POPULAR ENCYCLOPEDIA

A DICTIONARY OF GENERAL KNOWLEDGE

**SELEUCIDÆ**, a dynasty of kings who succeeded to that portion of the empire of Alexander the Great which embraced the whole of the eastern provinces, Syria, and a considerable part of Asia Minor. The term is derived from Seleucus, the name of the founder, as it was that of several subsequent kings belonging to the dynasty.—**SELEUCUS I.**, surnamed Nicator, the founder of the line, was born about 358 B.C. His father Antiochus was a general of Philip's, and he himself was one of the most distinguished officers of Alexander the Great, who invested him with the government of Babylonia and Media. On the death of Alexander in 323 Seleucus joined the conspiracy against Perdiccas, which resulted in the death of the latter, and in the second division of Alexander's dominions the satrapy of Babylon fell to his share. Like the other generals of Alexander, he asserted his independence, and this step being opposed by Eumenes, he obtained the aid of Antigonus against him. Their united efforts proved successful, but Antigonus now turned upon Seleucus himself, who, rather than face him, withdrew to Egypt (316 B.C.) Two or three years later he succeeded in inducing Ptolemy, the governor of Egypt, along with Lysimachus and Cassander, to take the field against their common enemy Antigonus, now waxed very powerful. Their forces proving victorious over Demetrius, the son of Antigonus, at Gaza, Seleucus was enabled to recover his satrapy of Syria, and his return to Babylon in 312 B.C. marks the commencement of the era of the Seleucides. (See EPOCH.) Having next recovered Susiana he conquered Media, and extended his possessions from the Euphrates to the Indus, and his rule was recognized by all the princes of the Orient. He assumed the title of king of this vast dominion in 306. In a later contest with Antigonus, in which he was aided by his former allies, he proved victorious a second time; and Antigonus losing his life in the struggle, his kingdom was divided among the victors. The whole of Syria and a great part of Asia Minor fell to the share of Seleucus. In subsequent contests against Lysimachus and Demetrius victory attended the arms of Seleucus, and his possessions were thereby extended so as to include the whole of Asia Minor. He was assassinated in 280 B.C. by Ptolemy Ceraunus. He is said to have been generous to a fault, was the protector of the arts and sciences, the benefactor of his people, and generally the most upright of Alexander's successors. Besides several cities of the name of Seleucia, he likewise founded Antioch and other places, which soon rose to considerable renown. He was succeeded by his son Antiochus I. (See ANTIOCHUS.)—**SELEUCUS II.**, surnamed *Callinicus*, succeeded his father Antiochus II. in 246.

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Having murdered his stepmother Berenice, Ptolemy Evergetes, her brother, invaded the territories of Seleucus to avenge her death. He penetrated beyond the Euphrates, and after a sanguinary struggle, the particulars of which are little known, concluded a ten years' truce with his foe, and then retired. After this Seleucus was engaged in contests with his brother Antiochus Hierax, Tiridatus, king of the Parthians, then with Ptolemy, who broke the truce; and indeed the whole of his reign was taken up with struggles against his adversaries, in most of which he was victorious. In an expedition, however, against the Parthians he was defeated by Arsaces I., king of Bactria. He died in 226 B.C., having reigned twenty years, and was succeeded successively by his two sons Seleucus III., who only reigned three years, and Antiochus III., surnamed the Great.—**SELEUCUS IV.**, surnamed *Philopator*, succeeded his father Antiochus III. in 186. Syria had been greatly weakened by the war carried on by Antiochus against the Romans, and Seleucus had to pay immense sums to the victors. His reign was signalized by few events of importance, and after he had been twelve years on the throne he perished from poison (175).—**ANTIOCHUS IV.**, surnamed *Epiphanes*, succeeded him, and is noted for his cruel persecution of the Jews, whose religion he attempted to extirpate. The later monarchs of this dynasty are not particularly distinguished, and with Antiochus XIII. (69–65 B.C.) the line became extinct. The power of the Seleucides began to decline as early as the reign of Seleucus II., and they successively lost, through revolts and otherwise, Bactria, Parthia, Armenia, Judea, and what subsequently remained was converted into a Roman province in 65 B.C.

**SELEUCIDES, ERA OF THE.** See EPOCH.

**SELIM I.**, Sultan of Turkey, was the son of Bajazet II., and born in 1467. Being of a more warlike disposition than his father, he was a greater favourite with the people, who sought to raise him to the throne in place of Bajazet, and in this they ultimately succeeded. In order to secure himself on the throne, his father being meanwhile removed by poison, he murdered his two brothers Ahmed and Korchud, and likewise his nephews, and throughout his whole career he scrupled not to remove, whether by fair or by foul means, whoever or whatever might stand in the way of his designs. To gratify his ruling passion for conquest, and the warlike fanaticism of the Janizaries, he entered upon a war with Persia in 1514. Having first massacred about 40,000 Shiites, who were in his own territories, he marched against Shah Ismail, and obtained a bloody victory at Tchaldaran, but the disaffected spirit which began to manifest itself among his troops obliged him to

content himself with the conquest of Diarbekir and Kurdistan. He next directed his arms against the Mamelukes of Egypt, and in 1516 obtained a victory over the Sultan Kansou-Ghawri, which left him master of Syria. Following up his victory by marching against Touman Bey, the successor of Kansou, he routed the Mamelukes in the plains of Gaza, and of Rudania in the following year, and then entered Cairo without opposition. Touman Bey, along with many others, were put to death, and Egypt, which had been an independent empire since the time of the Crusades, was incorporated with the Ottoman Empire. The title of *iman* and the standard of the Prophet were at this time granted to Selim by the last descendant of the Abbassides, who at that time was residing in Egypt, and in consequence of this concession the sultans of Constantinople became the chiefs of Islam, the representatives of Mohammed. Owing to this proceeding Arabia acknowledged his supremacy. Soon after his return to Constantinople, and whilst meditating more conquests, he was surprised by death, September 22, 1520. Notwithstanding the fierce nature of this prince, he was yet a protector of letters, and himself a cultivator of the poetic muse. He was succeeded on the throne by Solyman I.

SELIM III., Sultan of Turkey, son of Mustapha III., was born December 14, 1761. Before he ascended the throne he meditated many plans of reform, by which he conceived the declining empire might be raised to its former altitude, and when he succeeded his uncle Abdul-Hamed in 1789 he proceeded to put these plans into execution. At this time, however, a war with Russia was going on, and required all his attention. The Turks were defeated at all points, and in 1791 Selim was compelled to cede Choczim to Austria, and in the following year he signed the Peace of Jassi, which required the surrender to Russia of all Turkish possessions beyond the Dniester. The amicable relations subsisting at this time between France and Turkey were interrupted by the French expedition into Egypt in 1798, and the Turks sought the aid of the English. But peace was concluded with France in 1802, and the friendly relations were renewed. Selim now entered with great ardour upon his system of reforms: he established cannon foundries, and organized a corps of troops, which he armed, clothed, and exercised in European fashion. This proceeding, however, was looked upon with jealousy by the people, and when in 1805 he ordained the enlargement of the *nizam-djedid*, as the new corps was called, the fanatic zeal of the people, kindled by the preaching of the dervishes, who represented this and the other reforms of the sultan as a departure from the religion of Islam, burst into open revolt. The attempts of the *nizam-djedid* to quell the rebellion were unavailing; they were overpowered, their commander was put to death, and the rebels marched upon Constantinople, and compelled Selim to yield the throne to his cousin Mustapha. An attempt afterwards made by Mustapha-Baraiktar, at the head of 4000 men, to reinstate Selim ended in failure, and was made the occasion of assassinating him (July 28, 1808). Selim thus fell a victim to his efforts for the reformation of Turkey. These thankless efforts, however, were not altogether fruitless, for manufactures had begun to flourish, thousands of looms were put in operation, and generally a number of improvements calculated greatly to benefit the nation effected.

SELIMNO, SLIVNO, SLIEVEN, or ISLIMDJI, a town of Bulgaria, in Eastern Roumelia, at the southern foot of the Balkans, on a small affluent of the Tondja, 70 miles north by west of Adrianople. It is the seat of a Bulgarian bishop, and has several schools,

including a technical one, besides manufactures of cloth, spirits, &c. Pop. in 1900, 24,548, mostly Bulgarians.

SELJUKS, a Turkish family which derived its name from Seljuk, the chief of a small tribe of the Hooi-He, which had gained possession of Bokhara and the surrounding country in the ninth century of our era. During the eleventh and twelfth centuries the Seljuks founded various dynasties in Mesopotamia, Persia, Syria, and Asia Minor. Among the most distinguished of these were the following:—(1.) *The Seljuks of Iran* or Bagdad, who ruled at Bagdad and Ispahan. This dynasty was the most powerful of them all, and boasted the most illustrious princes. The founder was Toghrul Beg, a grandson of Seljuk, who in 1038 made himself master of Khorasan, a Persian province, assumed the title of sultan, and obtained from the Calif of Bagdad, whose daughter he married, the dignity of governor-general or *emir-al-omrah*. He subsequently completed the conquest of Persia by the reduction of Irak-Arabi and Mosul about 1061. He died in 1063, and of his successors may be mentioned Alp-Aralan (1063-73), who vanquished and made prisoner the Greek emperor Romanus; Melek-Shah (1073-93), who was the most powerful prince of the dynasty, and by means of his generals conquered and annexed to his empire Arabia, Asia Minor, Armenia, Syria, and Palestine, and in the administration of the empire was signally aided by his minister Misam-el-Mouk, who was distinguished for the wisdom and moderation with which he regulated the affairs of the vast empire, and for the encouragement he gave to the arts and sciences; Mohammed-Shah (1105-18), who carried on successful wars in India and against the Crusaders; and Sanjar, who reigned from 1118 to 1158, and was one of the most illustrious of the Mohammedan princes. This dynasty became extinct in 1194 with Toghrul-Shah, who was vanquished by Tekesh, sultan of Kharizm.—(2.) *The Seljuks of Kerman*, who ruled in the three provinces of Kerman, and never acquired the same distinction as the preceding. Founded by Kaderi, a nephew of Toghrul-Beg, to whom the latter in 1039 confided the administration of these provinces. The dynasty subsisted till 1091.—(3.) *The Seljuks of Aleppo*, in Syria, founded in 1079 by Tutush, a brother of Melek-Shah, and to whom the latter intrusted the administration of Syria. This dynasty became extinct in 1114.—(4.) *The Seljuks of Damascus*, in Syria, founded in 1096 by Dekkak, a son of Tutush, who possessed himself of the city of Damascus, and whose successors reigned till 1155.—(5.) *The Seljuks of Iconium*, or of Asia Minor, founded by Soliman-ben-Kutulmish, one of the great-grandsons of Seljuk, to whom the Sultan Kalek-Shah granted a territory in Asia Minor. This was the longest lived of all the Seljuk dynasties. Under the reign of Alla-ed-Din IL, one of the last princes of the dynasty, the Turk Osman distinguished himself as chief captain. His descendants it was who founded the dynasty of Osman in Asia Minor. The whole of the extensive empire of the Seljuks now fell under Mongol domination. (See OTTOMAN EMPIRE.) Consult also Mirchond's History of the Seljuks, which has been translated from Persian into German (Giessen, 1838).

SELKIRK, an ancient royal and parliamentary burgh and market-town in Scotland, and county town of Selkirkshire, stands on an eminence overlooking Ettrick Water, 39½ miles s.e. of Edinburgh by the North British Railway. The town is irregularly but substantially built, is well paved with concrete, and is supplied with water pumped from the river. The County Buildings, a fine example of the old Baronial style; the town-hall, with a spire

110 feet high; the Victoria Hall, a diamond jubilee memorial; the public library and reading-room; and the monuments to Sir Walter Scott and Mungo Park, are the principal objects of note. There are two Established, three United Free, and several other churches; the high-school, and other schools. The manufacture of tweeds is carried on here to a considerable extent, forming the staple industry; also tanning, engineering, and stocking-weaving. The manufacture of shoes was long celebrated as a speciality of the town. Selkirk overlooks the field of Philiphaugh, where the Covenanters under General David Leslie completely defeated the forces of Charles I. under Montrose. The town commands a splendid view across the valley where the Ettrick and Yarrow meet, and is a favourite resort of tourists, being in close proximity to the classic spots of Borderland, Abbotsford, Melrose, Dryburgh, &c., on the one hand; the 'Forest', the Yarrow, St. Mary's Loch, and Gray Mare's Tail on the other. From Selkirk over 100 men marched to Flodden Field with James IV., of whom only four returned, proudly bearing a standard taken from the enemy. Selkirk, with Hawick and Galashiels, returns a member to Parliament. Pop. (1891), 5788; (1901), 5701.

SELKIRK, ALEXANDER. See ROBINSON CRUSOE.

SELKIRKSHIRE (formerly known as *Ettrick Forest*), an inland county of Scotland, bounded north by Midlothian, east by Roxburgh, south by Dumfries, and west by Peebles. Its extent is 28 miles north to south, and 18 east to west; consisting mainly of the two parallel valleys of the Yarrow and Ettrick. The area is 172,426 acres, of which more than five-sevenths are mountain and heath grazing land. It is generally hilly, the hills for the most part being ridge-shaped, and rounded at the tops. They vary in height from a few hundreds to 2000 feet, and as they are mostly smooth and green to their summits they afford excellent pasturage, while a few are here and there partly covered with heather. The hills appear originally to have been one large, high bed of Lower Silurian graywacke and clay-slate, now cut and subdivided by streams. In the west of the county extensive beds of porphyry are found alternating with slate and granite. The arable land, bearing the proportion of about one-eighth of the area, is in general of a light soil, producing the ordinary cereals and green crops. The dampness of the climate and other circumstances render the county altogether more appropriate for pasturage than tillage. About 5500 acres are under corn crops, chiefly oats; some 3000 under green crops, of which turnips is much the most important; and some 12,000 are in permanent pasture. Nearly 5000 acres are occupied by woods and plantations. The Cheviots are now nearly the prevailing breed of sheep, having almost superseded the black-faced, which are confined to exposed mossy lands; the cattle are chiefly of the shorthorn breed. The principal rivers are the Tweed, and its tributaries Ettrick and Yarrow, while the Gala and Caddon flow through parts of the county. The county contains some interesting historical scenes, such as the field of Philiphaugh; Oakwood Tower, still in remarkable preservation, said to have been the residence of Michael Scott, the wizard; Newark Castle, the scene of Scott's Lay of the Last Minstrel; and Bowhill, the mansion of the Duke of Buccleuch. Other places of interest are St. Mary's Loch and the Loch of the Lowes, midway between which is the monument to the Ettrick Shepherd. The celebrated song, *The Flowers of the Forest*, takes its origin from the slaughter of the men from Selkirkshire at Flodden. A good many of the inhabitants are engaged in woollen manufactures, having their chief seats in Selkirk,

the capital, and in Galashiels. Selkirkshire, together with Peeblesshire, returns one member to Parliament. Pop. (1881), 25,564; (1891), 27,712; (1901), 23,339.

SELTTERS (or SELTZER) WATER, a mineral water belonging to the class of acidulous waters, which is found at the village of Niederselters, near Limburg, in Wiesbaden, in the Prussian province of Hesse-Nassau. Similar springs are also at Oberselters, a village not far distant. The water is exported in great quantities, in stone bottles containing about 3 pints. Its chief ingredients are carbonic acid, carbonate of soda, and common salt. It acts as a mild stimulant of the mucous membranes, and as a diuretic; and is recommended as a beverage to those suffering from liver complaint.

SEMAPHORE (Greek, *sēma*, a signal, and *phorō*, I bear), a term originally applied to a signalling post in a system of coast telegraphy adopted by the French in 1803, and subsequently to any kind of signalling posts having arms moving round pivots placed at or near their extremities. The semaphore, from the ease and rapidity with which the movable arms could be worked, was much superior to any telegraph previously in use. The French semaphores consisted of upright posts with two or three movable arms, turning upon separate pivots, one above the other. Like other telegraphs previously in use these were mounted on the top of towers, erected in commanding positions, at the distance of from 5 to 10 miles apart. When signals were made at one tower they were read off at the next by means of a powerful telescope, and then transmitted to a third, and so on, if necessary, to the end of the series. In this way a message might be despatched with great rapidity. In 1809 Captain Pasley, an English officer who had previously constructed what he termed a polygrammatic telegraph, saw the French semaphore, and applied the principle of it to his own telegraph. As thus modified, it consisted of a vertical post with three opposite pairs of arms pivoted upon it at certain intervals, representing hundreds, tens, and units. The telegraphs upon the commercial line of communication between London and the Downs consisted of a modified form of Pasley's semaphore, having two vertical posts with two pairs of arms upon each. Till 1816 the admiralty had employed a telegraph which had been submitted in 1795 by Lord George Murray, and which consisted of several shutters placed in a vertical frame, by the opening and closing of which the signals were made. In the year named it was determined to substitute for these telegraphs semaphores constructed on the principle of those used in France, with certain improvements suggested by Sir Home Popham. In Popham's semaphore there were only two arms; but these being upon separate pivots, though on the same post, each of them could be made to assume six different positions, and in combination the two could give forty-eight signals, a number more than sufficient to express all the letters of the alphabet, together with the nine digits. The vertical post of this semaphore was a hollow hexagonal mast, which passed through the roof of the tower, and being fixed upon a pivot it could be made to turn so as to display its signals in any direction. The arms were worked from within the tower by winches in the look-out room. Each of the stations which connected the board of admiralty with Deal, Portsmouth, and Plymouth was in charge of a naval officer. It was not till the introduction of the electric telegraph that these government stations were superseded. A kind of semaphore is still in use on railways, and in ships, when the weather does not allow of flags being worked as signals.

**SEMELE**, a daughter of Cadmus by Harmonia, the daughter of Ares and Aphrodite. She was beloved by Zeus; but Hera, jealous of her husband's amours, determined to punish this successful rival. She persuaded Semele to entreat her lover to come to her arms with the same majesty as he approached Hera. This rash request was heard with horror by Zeus; but as he had sworn by the Styx to grant Semele whatever she required, he came to her bed attended by lightning and thunderbolts, and Semele was instantly consumed with fire. The child, however, with which she was pregnant, was saved from the flames by Zeus, who placed him in his thigh the rest of the time which he ought to have been in his mother's womb. This child was Dionysus (Bacchus), who afterwards carried Semele from the lower world and conducted her to Olympus, where she became immortal under the name of Thyone.

**SEMENDRIA**, or **SMEDERREVO**, a town in the Kingdom of Servia, capital of the department of same name, on the right bank of the Danube, at the confluence of the Jessava, 22 miles S.E. of Belgrade. It is pleasantly situated, rising in the form of an amphitheatre on a height encircled by vineyards; is the see of a Greek archbishop, and has a fortress which was taken by Prince Eugene in 1717, and was occupied by a Turkish garrison till 1867; but is poorly built, and is rendered unhealthy by the swamps in its neighbourhood. Its only manufacture is fire-arms, which are much esteemed. Its inhabitants are chiefly employed in trading, fishing, and cultivating the vine. Pop. in 1895, 7027.

**SEMINOLES**, a tribe of North American Indians, an offshoot from the Choctaw Muskoghees. They belonged originally to the Confederation of the Creeks, but, in consequence of disputes among the chiefs, they separated from these, and under the name of Seminoles, that is, fugitives, established themselves in Florida in 1750. In 1808 another accession was made to their numbers, which amounted in 1822 to 3900, of whom 1594 were braves. As they were in the habit of making raids upon Georgia, and plundering the white settlers, General Jackson was sent to punish them; and in 1823, on the cession of Florida to the United States, they engaged to retire into the interior and cease molesting the settlers. This engagement, however, they did not keep, and it was at length found expedient to have them removed altogether. By a treaty made with some of the chiefs in 1832 it was agreed that the whole tribe should transfer their settlements to the region west of the Mississippi now known as the Indian Territory. This treaty, however, was repudiated by the tribe, and a long and disastrous war commenced. The Seminoles, protected by the Everglades, morasses situated to the south of Lake Okeechobee, succeeded in repelling all the attacks of the American army, until, overwhelmed by numbers, they were finally obliged to succumb in 1842, when they were transferred to the Indian Territory. A small number of them, however, remained behind, and continued for a long time to give trouble to the Americans.

**SEMIPALATINSK**, or **SEMIPOLATINSK**, a town of Russian Central Asia, in the province of the same name, on the Irtysh. It consists chiefly of wooden houses facing the river. The principal buildings are the government offices, the custom-house, mosques, churches, the bazaar, and the barracks. The inhabitants carry on a considerable trade with the Kirghiz, and with Tashkend, Khokand, Bokhara, and Kashgar. Pop. (1897), 26,353. The province is nearly surrounded by the Russian provinces of Tomsk, Akmolinsk, Syr-Darya, and Semirechensk, but it has Chinese territory on the south-east. It has an area of 184,631 square miles, and a

population in 1897 of 685,197. It is mountainous in the south-east, and consists of steppe land watered by the Irtysh in the north-west. It is one of the warmest regions of Russian Asia, and has been called the Siberian Italy. Apricots and apple-trees grow wild. The chief occupation of the people is cattle-rearing. The inhabitants are Kirghiz, Cossacks, &c.

**SEMI-PELAGIANS**. See **PELAGIANISM**.

**SEMIRAMIS**, a queen of Assyria, whose history is enveloped in fable. As the story goes, she was a daughter of the fish-goddess Deroeto of Ascalon, in Syria, by a Syrian youth. Being exposed by her mother, she was miraculously fed by doves until discovered by the royal shepherds, the chief of whom took her to his own house and brought her up. Her surpassing beauty having attracted the notice of Onnes, the governor of Nineveh, he married her. She subsequently accompanied her husband to the siege of Bactra, where, by her advice, she assisted the king's operations. These services, but chiefly her uncommon beauty, endeared her to Ninus, the founder of Nineveh (about B.C. 2182). The monarch asked her of her husband; but Onnes refused to yield her, and when Ninus had added threats to entreaties hanged himself. Ninus resigned the crown to her, and commanded her to be proclaimed Queen of Assyria. Semiramis built Babylon, and rendered it the most magnificent city in the world. She visited every part of her dominions, and left everywhere monuments of her greatness. She was not less distinguished as a warrior, and conquered many of the neighbouring nations. Having been completely defeated on the Indus, she was either put to death or compelled to abdicate the throne, after a reign of forty-two years, by her son Ninyas. She has been accused of abandoned licentiousness. The whole history of Semiramis has the appearance of an oriental tale; there is nothing to indicate the date of her reign, and even her existence has been called in question by some. It is highly probable that she is merely a mythological being, the personification of the fructifying power of nature, and corresponding to Astarte, or the Greek Aphrodite.

**SEMITIC LANGUAGES**. See **PHILOLOGY**.

**SEMITIC** (or **SHZEMITIC**) **RACES**. See **ETHNOLOGY**.

**SEMLER**, **JOHANN SALOMO**, one of the most influential German theologians of the eighteenth century, was born December 18, 1725, at Saalfeld, where his father was a clergyman. In his early years he was surrounded by Pietists, whose strict views in religion and practice exercised a considerable influence upon his disposition. He went to the University of Halle in 1742, where he became a pupil of J. S. Baumgarten, whom he aided in his literary labours. In 1749 he went to Coburg, where he filled the post of professor at the gymnasium, and edited the Coburg Gazette. Shortly afterwards he was appointed professor of history and poetry at Altdorf, and in 1751 was made professor of theology at Halle, where he and Professor Baumgarten were opposed to all the rest of the theological faculty. His lectures on ecclesiastical history, hermeneutics, and dogmatics, were fully attended, and in 1757 he was made head of the theological seminary, after the death of Baumgarten, whose life he published in 1758. His works are full of learning, but exhibit little elegance. He died in 1791, after having excited many controversies, and incurred much obloquy by his extreme rationalistic views. Semler, though sometimes imprudent from want of tact, was a man of strict virtue, a most tender conscience, and a pious heart. Griesbach was his pupil. The value of Semler's labours towards illustrating the history of the sacred text, and contributing to a

right understanding of the New Testament by a reference to the condition and opinions of its authors, and the fearlessness with which he proceeded in his historical method of exegesis, and thus showed the human origin of many theological dogmas, will be long remembered, and acknowledged even by those who are opposed to many of his views. The principal of his works are—*De Dæmoniis quorum in Novo Test. fit mentio* (Halle, 1760); *Untersuchung der Dämonischen Leute* (Halle, 1762); *Versuch einer Biblischen Dämonologie* (Halle, 1776); *Vorbereitung zur Theologischen Hermeneutik* (Halle, 1760-69); *Apparatus ad liberam Novi Test. Interpretationem* (Halle, 1767); *Apparatus ad liberam Veteris Test. Interpretationem* (Halle, 1773); *Abhandlung von freier Untersuchung des Kanons* (Halle, 1771); &c. See H. Schmid's *Theologie Semlers* (Nordlingen, 1858), and Tholuck's *Vermischte Schriften*.

**SEMLIN** (Hungarian, *Zimony*), a frontier town of Hungary, in comitat Syrmia of Croatia-Slavonia, near the confluence of the Save with the Danube, on the road from Budapest to Belgrade, which is carried across the Save here by a railway bridge. It stands on a tongue of land formed by the two rivers, and consists of the inner town and suburbs called *Franzensthal* and *Josefstadt*. Semlin is the seat of a Greek archbishop, and contains several churches, some higher schools, and a hospital. It carries on a considerable trade by rail and river, the chief articles being agricultural produce, vegetables, fruit, hides, skins, cattle, and grain. Near it are the remains of the castle of Hunyady Janos, who died here in 1456. Pop. in 1890, 12,823; in 1900, 15,079.

**SEMMERING**, an Alpine col or saddle, on the borders of Styria and Lower Austria, 44 miles south-west by west of Vienna. There has long been a road over the Semmering Pass (3254 feet), and here there is also the famous Semmering Railway, the first of the continental mountain railways. The railway begins at Gloggnitz, and is carried along the face of precipices by means of fifteen tunnels and sixteen viaducts to Mürzzuschlag. The scenery along this portion of the line is of the grandest and most picturesque description. At its highest elevation, 2891 feet, the line pierces the Semmering in a tunnel 4667 feet long. Its entire length is 25 miles, and it was constructed at a cost of about £1,400,000 for the Austrian government between 1848 and 1853.

**SEMNOPTHECUS**, a genus of the section *Catarrhina*, or Old World Monkeys, and included amongst those forms in which an elongated tail is present, cheek-pouches and callosities being also developed. All the various species of this genus are inhabitants of Asia and Asiatic islands. One of the most familiar forms is the Entellus Monkey (*Semnopithecus Entellus*), or Sacred Monkey of the Hindus. The genus *Presbytes* has in some systems of Quadrumanous classification been substituted for that of *Semnopithecus*. The Proboscis Monkey (*S.* or *P. larvatus*, see plate at *APR*) forms another species belonging to this genus. This latter form is found in Borneo, and receives its familiar name from the length of the nose. The Entellus Monkey, so revered by the Hindus, is of a grayish or grayish-brown colour, with black hands, feet, and face. The Moor, Negro Monkey, or Budeng (*P.* or *S. Maura*) is another species sometimes included in this genus.

**SEMOLINA**, or **SEMOULE**, a term applied to the large hard grains of wheat flour retained in the bolting machine after the fine flour has been passed through its meshes. The wheat best adapted for the production of semolina is the large-grained species of Naples, Odessa, and Spain, and as it is much esteemed in France, the fine white Parisian bread

called *pain de gruau* being baked of it, skilful millers produce it in considerable quantities. It is used in Italy in making polenta, along with other ingredients, and large quantities are exported to Britain and other countries, where it is made into puddings.

**SEMPACH**, a town of Switzerland, in the canton and 8 miles north-west of Luzern, on the eastern shore of the lake of the same name. It is walled, flanked with towers in a very ruinous condition, and is poorly built. Its only claim to notice is derived from being the scene of a battle (July 9, 1386) which the Swiss gained over their Austrian oppressors, who left on the field 600 nobles, including their leader, Duke Leopold, and more than 2000 common soldiers, though the whole force opposed to them did not exceed 1400. Pop. 1200.—The Lake of Sempach, lying 1530 feet above sea-level and 160 feet above that of the Lake of Luzern, is about 6 miles long by 3 miles broad; and is embosomed among hills.

**SENAAR**. See **SENNAAR**.

**SENATE**. This term has been applied to bodies of very different powers and constitutions in different countries; but in this article we propose to treat only of the Roman Senate. The Roman Senate is said to have been first constituted by Romulus, and originally numbered 100 members; but under Tarquinius Priscus this number was increased to 300, so as to give 100 representatives for each of the three tribes into which the Patricians were divided. On the establishment of the republic a number of vacancies which then existed were filled up by the enrolment, among others, of some plebeians of equestrian rank. The new senators were called by way of distinction *conscripti*, which gave rise to the form of address, *Patres Conscripti* (that is, *Patres et Conscripti*), thenceforth adopted in addressing the whole senate. Regarding the mode of election, and the age at which a citizen was eligible for a seat in the senate during the time of the kings, nothing is known definitely. After the establishment of the republic we find the power of choosing the senators vested in the consuls and consular tribunes, and later in the censors. In the exercise of this power, however, they were restricted to those who had previously held magistracies, and as the magistrates were always elected by the people, the senate therefore still remained a representative body. All curule magistrates, and likewise the questors, had *ex officio* a seat in the senate, and a right to speak but not to vote. The election to the office of *princeps senatus* lay in the hands of the censors, and they usually appointed the eldest of the ex-censors, though later they gave the office to any senator they deemed most worthy. The age at which a man might become a senator during the republic is nowhere stated precisely, but it appears to have been about thirty-two; at the time of the empire the senatorial age was twenty-five, as fixed by Augustus. There appears to have been nothing fixed with regard to the property necessary for a senator until Augustus set it down at 400,000 sesterces, increasing it afterwards to 1,200,000 sesterces. No senator was allowed to engage in commerce, but this law was frequently violated. During the republic the regular meetings of the senate (*senatus legitimus*) were held on the kalends, ides, and nones of each month; extraordinary meetings (*senatus indictus*) might be held at any time except on *dies atri*, and days on which the comitia met. The right of convoking meetings was vested in the curule magistrates. Originally the place of meeting was the Curia Hostilia, but it afterwards met in different *templa*. At first the powers of the senate were very extensive.

but these were gradually circumscribed through the ever-extending jurisdiction of the comitia tributa. After, however, the plebeians had attained to a position of equality with the patricians the powers of the senate remained more or less fixed. It had supreme superintendence in matters of religion, controlled the public treasury, despatched and received embassies, sanctioned treaties, assigned their provinces to consuls and prætors, determining whose command should be prolonged; decreed all public thanksgivings and triumphs, took cognizance of crimes committed in Italy, and settled all disputes which might arise among the municipia and colonies of Italy. In times of great danger the senate had the power to invest the consuls with dictatorial authority by the formula, 'Videant consules ne quid respublica detrimenti capiat.' It is uncertain how many senators were necessary to constitute a legal meeting during the republic. Augustus, after having fixed the number of senators at 600, required the presence of 400 to constitute a full assembly; but he afterwards reduced this number, and at a later period seventy were sufficient. The number of senators, after having remained at 300 for several centuries, was raised by Sulla to 600, he having added 300 equites to the senate. A further increase of 300 was made by Julius Cæsar, and at one time there were as many as 1000 senators; but Augustus, as already stated, reduced the number to 600. The numbers fluctuated very much during the empire, and latterly were greatly diminished. In the conduct of business the presiding magistrate commenced by repeating the words 'Quod bonum, faustum fortunatumque sit populo Romano Quiritibus,' and then laid before the assembly the propositions upon which their decision was required. The majority of votes always decided a question. The votes were either counted by the president (*numeratione*), or the members who voted on the same side separated from those who voted otherwise (*decussio*). A decree of the senate was called a *senatus consultum*. If a tribune opposed the decree, or the senate was not full, the act was called *senatus auctoritas*, and was submitted to the people. The tribunes of the people could reject every proposition before the senate by their veto. The authority of the senate was styled *auctoritas*; that of the people, *potestas*: the former decreed (*decernebat*), the latter ordered (*jubebat*). Still, in those cases in which it was subject to the decisions of the people (*plebiscita*) the authority of the senate was extensive, and in other matters its *acts* (*senatus consulta*) had the force of laws. Under the emperors the senate gradually lost its political consideration, but until the time of Constantine the Great many imperial decrees, which the senate issued by the command of the emperors, were called *senatus consulta*, and took the place of the laws enacted by the people (*leges*). It finally became so submissive that it often decided on the propositions of the emperors, without deliberation, by acclamation. The Roman senate, constituted as it was in its earlier days of the collective wisdom of the citizens, was by the consistency, wisdom, and energy with which it acted the chief instrument in raising the republic to the prominent position to which it attained.

SENECA, a lake in the United States, in the west of the state of New York, about 25 miles south of Lake Ontario, into which it discharges itself by the Seneca and Oswego. It is a long and narrow expanse, about 37 miles long from north to south, and only 2 to 4 miles broad; lies 441 feet above the Atlantic, has a depth of 630 feet, and was never known to be frozen over till 22d March, 1856. It communicates with the Erie Canal, and is navigated

by steamers which ply between Watkins, its southern, and Geneva, its northern extremity.

SENECA, LUCIUS ANNEIUS, son of the following, called Seneca the Philosopher, was born at Corduba (Cordova) a few years before the commencement of the present era. He accompanied his father to Rome at an early age, and received from him a careful education. Gifted by nature with excellent talents, and being fond of study, the young Seneca made rapid advances in knowledge. The Stoic philosophy had peculiar charms for his grave character, and he cultivated it with ardour. In 41 A.D., being through the jealousy of Messalina accused of undue intimacy with Julia, a niece of the emperor Claudius, he was banished to Corsica for eight years. It was during this period that he wrote one of his best treatises, *Consolatio ad Helviam*, and also *Consolatio ad Polybium*, which is characterized by its gross flattery of the emperor. In 49 Seneca was recalled, through the influence of Agrippina, who had just married her uncle Claudius, and was made prætor. He was subsequently appointed joint-tutor, with Burrhus, of the young Domitian, afterwards the Emperor Nero, one of whose chief advisers he became on his accession to the imperial throne in 54. His influence was used to check the vicious propensities of Nero, but he at the same time took advantage of his position to accumulate a vast fortune said to have amounted to 300,000 sesteria, or £2,421,870 of our money. He supported Nero in his opposition to Agrippina his mother, and was considered to be even a party to her murder. This deed was the beginning of a still more vicious career on the part of Nero. Seneca feeling that his presence was irksome to the emperor and his wealth an object of his cupidity, he offered to surrender his property and retire on a small competency. This Nero refused, and thenceforth, according to Tacitus, Seneca 'kept no more levees, declined the usual civilities which had been paid to him, and under pretence of indisposition avoided appearing in public.' The conspiracy of Piso gave the emperor a pretext for putting his teacher to death, though there was not complete evidence of Seneca being a party to the conspiracy. The only favour which the tyrant was willing to grant him was the choice of the manner of his death. Seneca caused the veins of his arms to be opened; but on account of his age and the extreme meagreness of his body the blood flowed so slowly that he caused the veins of his legs also to be opened, and finding this fail, drank a dose of hemlock, but with little effect. He was at last placed in a warm bath, and then taken into a vapour stove, and was there suffocated. His wife, Paulina, determined not to survive him, cut her own veins, but the attendants frustrated her efforts at self-destruction. Seneca died with the calmness of a Stoic philosopher, A.D. 66. We have several works under his name, partly prose and partly poetical. The former consist of letters and treatises on different subjects of philosophy; the latter of tragedies. The former are replete with just, profound, and excellent remarks, conveyed in a form not entirely unworthy of them; yet they bear marks of the influence of the spirit of the age—the inclination to the Stoic philosophy, and the style is too often artificial, antithetical, and turgid. His tragedies are much inferior to his letters and some of his philosophical works. It is by no means settled that the tragedies are actually by him, and some of them have been attributed to his father. They are formed on the Greek plan, but are far behind their models in every respect. They have so little of a dramatic character that they seem to have been composed merely to be read or declaimed. Besides the treatises already men-

tioned Seneca wrote *De Ira*; *De Consolatione ad Marciam*; *De Providentia*, a discussion of the question why evil happens to good men; *De Animi Tranquillitate*; *De Constantia Sapientis*; *De Clementia*; *De Brevitate Vitæ*; *De Vita Beata*; *De Beneficiis*; 124 Epistles ad Lucilius, containing moral maxims and observations; and *Questionum Naturalium Libri septem*, a collection of physical facts from various writers. The best edition of Seneca's works are the Elzevir (Amsterdam, 1672), Lemaire's, with the notes of Bouillet (Paris, 1827-28, three vols.), Fickert's (three vols., Leipzig, 1842-45), and Haase's (three vols., Leipzig, 1852 and following years). There have been several translations of Seneca into English.

SENECA, MARCUS ANNÆUS, a rhetorician, and the father of the preceding, was a native of Corduba, in Spain, and was born about 61 B.C. He went to Rome during the reign of Augustus, and there taught rhetoric with great success for several years. Returning afterwards to Spain, he there married Helvia, by whom he had three sons. The latter years of his life seem to have been passed at Rome, and his death is supposed to have occurred towards the close of the reign of Tiberius. He was the author of some rhetorical works, the remaining fragments of which are often contained in editions of the works of Seneca the Philosopher, and have been published separately. These are far from supporting the fame which he acquired, being of little value either in point of form or of matter.

SENECA INDIANS, a tribe belonging to the Iroquois or Six Nations, and formerly occupying the western portion of the state of New York, and part of the north-west of Pennsylvania. There are still about 3000 of them located on reservations in New York state, near Lake Erie and Niagara, and a small number in the Indian Territory.

SENEFFE, or SENEZ, a small town of Belgium, in the province of Hainault, 17 miles E.N.E. of Mons; with a fine castle. Its chief interest is due to its proximity to the scene of the great battle in 1674, in which the French under Condé defeated, after a sanguinary struggle, William of Orange (afterwards William III.), who was at the head of the forces allied against France. The allies numbered 60,000, while the French only reached 30,000.

SENEGAL, a river of Western Africa, the mouth of which is in lat. 15° 48' N., but which in its course through Fouta-Toro advances a degree farther north. It is formed by the union of the Ba-fing and the Bakhoi, the former rising in the Fouta-Jallon mountains, south-west of Timbo, and the latter north of Didi. From the opposite or western side of the mountain in which it rises springs also the Falemé, another great branch of the Senegal, which runs north in a more direct course till it joins the Ba-fing in Galam. The latter receives on its eastern side the Kuniakari or Tarakole River, and the Ba-Wullima or Red River, both large streams. The Senegal is navigable up to the cataracts of Félou in Kasson, about 700 miles from its mouth. Above those falls it again assumes the appearance of a great river, but its capabilities are not practically known. The Senegal is much wasted in the lower part of its course by the numerous *marijots* or channels which carry its waters through the adjacent plains; and its mouth is dangerously barred, so as to be at most seasons accessible only for small vessels.

SENEGAL, a French colonial possession in West Africa, comprising the coastal strip from the British colony of Gambia north to Cape Blanco, and extending inland to the Soudan military territories of France. The greater part of this region belongs to the district known as Senegambia, for which see

the following article. By a decree issued in 1899 the colony of Senegal was extended so as to include the western part of the former French Soudan territory, and the area of Senegal is therefore now about 200,000 square miles, the population being over three millions. The whole is under a civil governor, who has direct jurisdiction in the communes of St. Louis, the capital, on the coast, Dakar, near Cape Verde, the chief port, Goree, and Rufisque. Several other districts are under administrators, but the greater number of the inhabitants are only partially under the control of the French authorities. The colony is represented in the French chamber by one deputy. Dakar is fortified, and there is a military force of about 3000 men, nearly one-half of them natives. Among the products of the colony are millet, maize, and rice, cultivated by the natives; gums, castor-beans, earth-nuts, coco-nuts, rubber, and kola. Cattle, sheep, goats, and camels are domesticated, and some weaving, pottery-making, and other industries are carried on. In 1900 the imports were valued at over £1,800,000, and the exports, consisting chiefly of earth-nuts, gums, and rubber, at over £1,300,000. The length of railway open in that year was nearly 250 miles, the chief line being that from Dakar to St. Louis. A line from Kayes, at the head of navigation on the Senegal, to the Niger is well advanced.

SENEGAMBIA, an extensive region of Western Africa, comprising the countries between lat. 10° and 17° N.; lon. 4° and 17° 30' W.; bounded on the north by the Sahara, south by Guinea, and west by the Atlantic. The western portion of the country is a low, flat, and to a great extent swampy plain. East of this the country is mountainous, and the valleys seem all to run north and south. The principal rivers are the Senegal (see SENEGAL), the Gambia (see GAMBIA), the Juba or Rio Grande, and the Nuñez. In the level tract bordering the coast the rivers during floods overflow their banks, inundating the plains, and become connected with one another by means of canals. On the lower Senegal, as far as the inundation reaches, vegetation is very luxuriant. Rice, maize, and other grains, with bananas, manioc, and yams, are cultivated equally on the hills and plains. The orange, citron, and other fruits introduced by the Portuguese are now extensively cultivated on the hills. Wild animals comprise the elephant, hippopotamus, monkeys, antelopes, gazelles, lion, panther, leopard, hyenas, jackal, crocodile, &c. The climate is intensely hot, and very unhealthy for Europeans. The inhabitants are of many races, the principal being the Yofos, Foola, and Mandingoes. These negro tribes inhabit for the most part Middle Senegambia, between the Senegal and the Gambia. Upper Senegambia, to the north of the Senegal, is largely inhabited by Moors, who carry on an extensive trade in gum, &c., with the Europeans. The region is settled in various parts by Europeans. The Portuguese own the Bissagos Islands and some coast territory at the mouth of the Rio Grande, while the British own the Gambia settlements at the mouth of the Gambia. Otherwise the whole of Senegambia is now under French influence. The population of Senegambia is estimated at 12,000,000, and its area at from 400,000 to 700,000 square miles.

SENEGA (or SNAKE) ROOT (*Polygala Senega*), a plant belonging to the natural order Polygalaceæ, has a woody, branched, contorted root, about  $\frac{1}{2}$  inch in diameter, and covered with ash-coloured bark. It is inodorous. The taste is at first sweetish and nauseous, but after being chewed for a moment becomes pungent and hot, producing a very peculiar tingling sensation in the fauces. Medically it is

considered stimulating, expectorant, and diuretic, and in large doses emetic and cathartic. It has been celebrated as a cure for the bite of the rattle-snake, and on a basis equally destitute of foundation has been proclaimed as a remedy in pulmonary complaints. The plant grows to the height of about 1 foot, producing several herbaceous stems from the same root. The leaves are alternate, entire, oval-lanceolate, smooth, and sessile. The flowers are small, white, disposed in a slender, terminal raceme. Its principal virtues are due to the presence of a very acrid substance, which has been called senegin, polygalin, and polygalic acid.

SENECHAL, originally a steward or major-domo, whose duty it was to superintend the affairs of his lord's household. The seneschalship afterwards rose to be an office of dignity, and was held by military commanders. In France the *sénéchaussée* was the jurisdiction of a *sénéchal*, as in the course of time that officer came to be invested with judicial functions, and was the leader of the nobility within a certain district. The royal seneschal was called *grand sénéchal*, in contradistinction to the seneschals of the feudal princes, the dukes of Normandy, Brittany, Guienne, Burgundy, &c.

SENIOR, NASSAU WILLIAM, political economist, eldest son of the Rev. J. R. Senior, vicar of Durnford, Wilts, was born at Compton, Sept. 26, 1790. He was educated first at Eton and afterwards at Oxford, where he graduated as M.A. in 1815. He was called to the bar at Lincoln's Inn in 1819, and in 1825 he was elected to the chair of political economy at Oxford, of which he was the first professor. In 1830 he resigned this office, but was re-appointed in 1847. In 1836 he was appointed a master in chancery during the chancellorship of Lord Cottenham. Senior was a member of the commission of inquiry appointed in 1832 to investigate the abuses of the then existing poor-law system; and he was subsequently nominated one of the commissioners of national education under the presidency of the late Duke of Newcastle. Of his writings, which comprise a number of excellent treatises on political economy, and some pamphlets on social and political questions, mention may be made of *An Outline of the Science of Political Economy* (London, 1836), originally contributed to the *Encyclopædia Metropolitana*; *Political Economy* (London, 1850); *Essays on Fiction* (London, 1864), a collection of articles on Scott, Thackeray, and others, which had been previously contributed to leading reviews; and *Historical and Philosophical Essays* (two vols., London, 1865), a posthumous publication consisting of articles reprinted principally from the *Edinburgh Review*. Senior died at Kensington Gore, June 4, 1864. His daughter has published several volumes of extracts from his valuable journals.

SENLIS, a town in France, department of Oise, 30 miles south-east of Beauvais. It is in general well built, but many of the streets are narrow and winding. It has an ancient castle flanked with round-towers; a cathedral, said to have been founded by Charlemagne; a public library, and manufactures of coffee, chicory, chocolate, &c. Pop. in 1896, 5873.

SENNA. The leaflets of several species of *Cassia* furnish the senna of commerce, of which there are several varieties, but the exact botanical source of some of the commercial kinds is still uncertain. Alexandrian Senna is obtained chiefly from *Cassia acutifolia*, whilst Tinnevely Senna is produced chiefly by *C. angustifolia*. These are the kinds most in repute in this country, but they are frequently adulterated with the leaves of other plants having similar properties. Senna is a useful laxative medicine, but it is apt to cause sickness and griping.

SENNAAAR, or SENNAAR, a region in Northern Africa extending between the Bahr-el-Azrek or Blue Nile, and the Bahr-el-Abiad or White Nile; area estimated at about 115,000 square miles. It was formerly an independent Negro kingdom, afterwards subject to Egypt, and forms part of the Soudan. The towns or villages lie chiefly along the banks of the Blue Nile, or Bahr-el-Azrek, and are tolerably numerous. The soil is for the most part level, in some parts barren, but on the banks of the rivers fruitful and well cultivated. Among the animals are camels, sheep, cattle, swine, and the African wild animals. Rice, grain, melons, tobacco, sugar, senna-leaves, ebony and sandal wood, and palms are among its productions. The climate is warm; in summer insufferably hot. The rains which follow the hot weather render the air unhealthy. Sennaar is a region of great ethnical confusion, the Nubian, Negro, and Galla stocks being commingled in all degrees, but the fundamental type appears to be that of the Fungs, who are a race with many fine qualities. The inhabitants may be classified according to colour thus:—The Assari (yellow), of manifestly Arab origin; Hamar (red), mulattoes; Azrek (blue), darker than the Hamar; the Akhdar (green) and Elkat Fatteloh, both very dark and little removed from the Soudan (black) or Nubah, unmixed Negro slaves recently imported. Sennaar was separated from the Egyptian territories during the Mahdist period, but it is now a first-class district of the Egyptian Soudan. Sennaar, the former capital, on the Blue Nile, has about 6000 inhabitants, and is the centre of a pretty extensive trade, which promises to develop under improved conditions.

SENNACHERIB (Heb. *San'cheribh*), an Assyrian king, son of Sargon, succeeded his father on the throne B.C. 705. Among his first acts as king was the suppression of the revolt of Babylonia, and after accomplishing this he directed his arms against the Aramean tribes on the Tigris and Euphrates, of whom he took 200,000 captive. He then reduced a portion of Media, till then independent; placed under tribute Tyre, Aradus, and other Phœnician cities; advanced against Philistia, made war upon Egypt, and finally marched against Hezekiah, king of Judah, who had revolted. Sennacherib came up against all the fenced cities of Judah and took them, and Hezekiah, terrified, yielded in a panic, and paid the tribute exacted, namely, 300 talents of silver and 30 talents of gold. On his return to Assyria Sennacherib made another attack on Babylonia, and afterwards re-invaded Judah. Having marched through Palestine he laid siege to Libnah and Lachish, and finding that his messengers Tartan, Rabearis, and Rabshakeh had failed in obtaining the submission of Hezekiah, he wrote a letter to Hezekiah meant to intimidate him; but before he could bring his forces against the city a visitation from the Lord during the night caused the death of 185,000 of his troops. In consequence of this terrible calamity Sennacherib returned to Nineveh and troubled Judah no more. From Herodotus we learn of the Egyptian tradition regarding the destruction of Sennacherib's host, which is that a multitude of field-mice devoured all the quivers and bow-strings of the enemy, and gnawed the thongs by which they bound on their shields. No mention of the destruction of his host is found in the monuments of Sennacherib, and there are considerable discrepancies as to the dates of the invasions of Judah between the scriptural account and that preserved in the monuments, and these discrepancies do not appear to have been yet accounted for in a satisfactory manner. Sennacherib was one of the greatest of the Assyrian kings, and was not only a great warrior but also a great builder. His

greatest architectural work was the palace of Koyunjik, which covered an area of fully 8 acres. Of the death of Sennacherib all that is known is contained in the brief Scripture statement of 2 Kings xix. 37 and Isa. xxxvii. 38, from which it appears that he was murdered by his own sons.

SENNEFELDER, ALOIS. See LITHOGRAPHY.

SENONES, one of the tribes of ancient Gaul, bordering on the Belgæ and occupying a fertile country in which is situated the modern Sens, a town that represents their capital. The Senones were at first friendly towards Cæsar, but afterwards resisted his measures, upon which he entered their country, and took prisoner Acco their leader. In B.C. 52 they sent a large force to join the other Gauls who fought against him at Alesia (see GAUL).

SENS, a town of France, in the department of Yonne, finely situated on the right bank of the Yonne, 81 miles N.N.W. of Auxerre. It is an ancient place, having been the capital of the Senones (see above); consists of regular, spacious, well-built streets, and has a fine cathedral of pure early Gothic (founded in 972, rebuilt in the twelfth century), with various noteworthy features, more especially a west front, pierced by three portals adorned with fine sculptures; an interesting building of the thirteenth century adjoining; an archiepiscopal palace, museum, public library, lyceum, &c. Pop. in 1896, 13,513.

SENSATION is the consciousness of an impression, the perception of an impression made upon a nerve. Now it is well known that consciousness is inextricably linked with the integrity of certain parts of the larger brain, of certain groups of nerve cells somewhere on the surface of the anterior portion of the cerebral hemispheres. To these groups or masses of nerve cells the phrase 'centres for consciousness' is applied, though their exact situation has not yet been accurately determined. If, then, consciousness arises as a result of some change occurring in the cells of which these centres chiefly consist, and if, without some such change in the higher brain, there is no consciousness, then when a pin is thrust into the skin of the foot, let us say, and we feel it, or have a sensation of pain, it is clear that that sensation is only the last of a series of changes following one another with inconceivable rapidity, the first of which was the change in the skin due to the pin-thrust, the last of which was the change in the centres for consciousness. It is clear also that the change in the skin was the cause, operating through some intermediate apparatus, of the change in the centres for consciousness. It ought to be equally obvious that the term 'sensation' is applied only to the last of the series of changes, not to that occurring in the skin, but only to that occurring in the brain. If the change occurring in the skin be the cause, through some intermediate apparatus, of the change occurring in the brain, to which latter only the term sensation is properly applied, then it is possible to imagine some break-down in the intermediate apparatus, the consequence of which would be that the change in the skin, due to the pin-thrust, would fail to produce a change in the centres for consciousness; that is to say, no sensation would be produced, the pin-thrust would not be felt. Or, suppose the intermediate apparatus intact, but the centres in the brain destroyed or under the influence of some drug, which prevents any change occurring in them, or under the influence of sleep, then the change in the skin is duly transmitted by the intermediate apparatus to the centres in the brain, but fails to arouse them to any activity, and so again there is no sensation, no pain felt. Now let us generalize this illustration; to the change produced in the skin the term 'impression' is applied, to the change produced in the

centres for consciousness the term 'sensation' is applied, and the intermediate apparatus consists of nerves. Nerves are distributed to the skin, and end in the skin in a variety of ways. A pin cannot be thrust into the skin in a healthy person without in some way affecting some of the endings of the nerves. The impression thus produced is transmitted along the nerve up the limb, and, after a more or less circuitous course up the spinal cord or spinal marrow, reaches the brain, is transmitted through the brain along nerve tracts till the centres for consciousness are reached, which are thrown into activity by the impulse acting on them, and then the impression made on the skin is perceived and sensation arises. In this case, then, the sensation of pain is the consciousness of an impression made on the skin of the foot by the pin-thrust and transmitted along nerves to the brain. Such nerves, which convey impressions inwards, are called *centripetal* (centre-seeking) or *afferent* (*ad*, to, and *fero*, I carry), and sometimes, though inaccurately, *sensory* nerves. 'Sensory nerves' is a phrase that is quite common though unscientific. For, after what has been said, it will be noted that 'sensory' is applied to the nerve because it carries inwards an impression which frequently gives rise to a sensation. But whether or not the impression causes a sensation does not depend on the nerve, but only on whether the impression reaches and sufficiently rouses the centres for consciousness. There is no doubt that there are impressions constantly being transmitted inwards by afferent nerves from the surface and from the interior of the body which do not give rise to sensations, never reach consciousness, but nevertheless produce changes of great moment for the general well-being of the body. Thus when a strong beam of light falls on the eye, the pupil contracts, and so limits the amount of light admitted to the interior. The chain of events here is that the light produces an impression on the eye, which is transmitted inwards by an afferent nerve, and leads to changes in centres in the brain (not, however, centres for consciousness) which issue in a stimulus being transmitted to the constricting muscle of the pupil, and thus in narrowing of the pupil. These changes are of vital moment for the integrity of the eye, and yet, though they are constantly occurring, no one is conscious of them. If, instead of a pin being thrust into the skin, something be made to touch lightly the skin on some part of the body, a series of events, similar to that already described, occurs, and we thus become aware of something in contact with the skin. If a drop of strong acid be laid on the skin, nerves are irritated, and again by a similar process we become conscious of the offending substance. If a hot wire be brought near to the skin, even without touching it, the radiant heat from the wire produces a marked impression on the nerves of the skin, which in due season rouses consciousness. If we swallow something too hot, the unduly hot substance acts on the endings of afferent nerves in the mucous membrane of the gullet and stomach, an impulse is transmitted inwards, and we become aware of pain. If inflammation of the bowel, kidney, or other organ arise, afferent nerves distributed to the organ involved are affected, impressions are, as in the former cases, transmitted to centres for consciousness, and uneasiness, discomfort, or actual pain, more or less severe, is the form of sensation aroused. If the body be placed for a time in any unusual, constrained, cramped, or twisted position, the unusual pressure or twist acts in time upon afferent nerves, and the impression that duly reaches consciousness serves as an intimation of the discomfort some part of the body is suffering. Thus it appears that by sensations of various kinds we become aware of the general condition of the body

and of the various bodily organs, and that by the same means we derive information concerning the relation of the body to the external world. The illustrations that have been used show how, from the skin, we derive impressions that lead to sensations of contact, pressure, heat, and pain, and we know how by such sensations we derive valuable and extensive information regarding external objects. Careful investigation shows that all parts of the skin covering the body are not equally readily impressed by contact or by heat or by cold. It is found that some parts are more readily affected by contact than others, some parts more readily affected by heat, and so on. There is reason to believe that this is due to the way in which the nerves end in the skin (see TOUCH). In some parts of the skin the nerves end in little structures called 'touch-bodies,' others end in other ways. One form of termination is readily affected by contact, another by heat, another by cold, and so on. These structures are called 'terminal organs.' So the sensation roused in the brain will depend on the kind of terminal organ mainly affected. So we add to what has been said about the mechanism of a sensation, and amplify our description thus—a sensation is the result of an impression made on a terminal organ, which is transmitted inwards by an afferent nerve, and reaches a centre in the brain where consciousness of the impression arises. Now light plays upon the body, but the vibrations to which, physicists tell us, light is due are unable to produce any effect upon the terminal organs of the skin that would excite consciousness. So the body is provided with a special apparatus—the terminal organ of vision, the eye—so constructed as to be affected by light. Thus, through this special apparatus, an impression is produced, is transmitted inwards by an afferent nerve, the optic nerve, to a centre in the brain, where the sensation of light is aroused. Sound is due to vibrations of another kind, but these neither affect the eye nor the skin. Another special apparatus, so constructed as to be excited by sound vibrations, is, therefore, provided, the terminal organ of hearing—the ear—from which the impression is transmitted inwards by a special nerve, the auditory nerve, to a special centre in the brain, where the sensation of sound is aroused. Similarly in the mucous membrane of the tongue and palate there are special terminal organs, affected in a particular way by rapid substances, from which impressions are conveyed inwards by special afferent nerves to special centres, resulting in the production of sensations of taste. Similarly in the upper part of the nasal cavity are the special terminal organs of smell. Thus there are special kinds of apparatus, affected only by special physical causes, the excitation of which ends in the production of special sensations. These special sensations are those included under the term touch, and those of vision, hearing, taste, and smell. It is by the special senses that we derive information concerning external objects and maintain our relations with the external world. But, as already indicated, from every part of the body, from the internal organs as well as from the surface, impressions reach the nerve-centres. Many of these never rise to consciousness, but nevertheless, through the intimate relationship existing between all parts of the nervous system and all parts of the body, they play most necessary parts in the harmonious working of the bodily organs. It is by such impressions, for example, playing upon certain nerve-centres (not centres for consciousness) that the rhythm of the heart, the rate of breathing, the distribution of blood to various organs according to their needs, are maintained. Such impressions pass inwards by afferent nerves, but not arousing the centres for consciousness, they do not give rise to

sensations. Many impressions from internal organs, however, do reach centres for consciousness and give rise to sensations, not of the special, well-defined character of sensations of taste, sight, &c., but of a more vague, ill-defined sort. It is doubtless a combination of such that gives rise to the feeling of general well-being we experience when all the bodily organs are in vigorous healthy activity. It is probably impressions reaching the centres for consciousness from various organs of the body, impressions of an abnormal kind, that occasion feelings of uneasiness, of discomfort, of being 'out of sorts,' as we phrase it. These are all classed together as general sensations, and the sensations of hunger and thirst are particular forms of them.

So that by the special sensations we derive information concerning the external world, and by general sensations we derive information concerning our own body.

In regard to the special senses, it is to be observed that the afferent nerve always conveys the same kind of impression. Thus in the case of the eye, the optic nerve, under normal circumstances, only transmits inwards impressions due to light, and these impressions are always conveyed to one special centre, the centre for vision. This nerve and this centre, that is to say, are set apart for this special business. The optic nerve, to put it in another way, is habituated to transmitting from the eye impressions due to light, and the centre for vision is habituated to receiving impressions by the optic nerve due to light falling on the eye. Thus it comes about that if the optic nerve be excited in any way, the impression that reaches the centre gives rise to a sensation of light, just as if the impression had been due to the usual cause. Let the optic nerve be mechanically irritated, as by a blow on the eye, the person seems to see stars; irritate the nerve by an electric current, the person sees flashes of light. Again, let the centre in the brain be excited by abnormal causes, by drugs acting on it through the blood, by alcohol, and so on, the person sees objects, as if they were in the external world, which are only the creations of the excited brain. In the same way if the auditory nerve be excited in any abnormal way, sounds are heard, 'singing in the ears,' &c., and abnormal stimulation of the centre in the brain will produce sensations of sound, sometimes almost indistinguishable from sensations due to ordinary causes. These illusions of the senses are, of course, rendered possible by the fact that, as the result of education and habit, we refer the causes of our sensations to outward objects. If something touches the skin, we feel it, but we also see the touching body in contact with the skin. Thus, from our babyhood upwards we associate sensations, arising from impressions made on the skin, with external objects in contact with it. Sometimes in jaundice the nerve terminations in the skin are irritated by the circulation of blood containing biliary matters, and the person can hardly rid himself of the idea that insects, such as ants, are crawling over his body, in spite of the evidence of his eyes. A similar explanation is offered for the fact that a person who has had a leg amputated often complains of pain in the amputated foot. The nerve in the stump is irritated, and in accordance with habit the pain is referred to what ought to be the termination of the nerve, that is, to a position in space that would have been occupied by the foot of that leg had it been intact.

It remains to be added that impressions made upon a terminal organ of sense, and on a centre, last an appreciable time. That is to say, two impressions on the same sense organ, following one another, require to be separated by a certain interval of time

to be distinguished from one another in consciousness. If they follow one another so quickly that the effect of the first has not died away before the second is produced, the two are fused in consciousness, and are appreciated only as one. An illustration of this is the appearance of a luminous circle by the whirling in the air of a piece of string, the end of which has been lighted and then blown out to produce a glowing point. The separate impressions of the glowing point falling upon the retina from different points in space become fused into the sensation of a circle of light.

The special senses and the structure of the organs of sense are described under the headings EYE, EAR, NOSE, SMELL, TOUCH, &c., whilst the articles on the nervous system will afford information regarding the various parts more or less intimately concerned in the conveyance of impressions and production of sensations.

**SENSES.** See special articles EYE, EAR, NOSE, SMELL, TOUCH, &c.; also NERVE, SENSATION, &c.

**SENSITIVE FLAMES,** gas flames which are easily affected by sounds. The most sensitive flame is produced in burning gas issuing from a small taper jet. Such a flame will be affected by very small noises, as the ticking of a watch held near it, or the chinking of small coins 100 feet off. The gas must be turned on so that the flame is just at the point of roaring. Professors Barrett and Tyndall have performed many highly interesting experiments with these flames.

**SENSITIVE PLANT** (*Mimosa pudica*; natural order Leguminosae), a plant celebrated for its apparent sensibility, shrinking and folding up its leaves on the slightest touch. It is a native of tropical America, but is often seen in British greenhouses. It is a low plant, with white flowers, disposed in heads, which are rendered somewhat conspicuous by the length of the stamens; the stem is prickly; the leaves are compound, consisting of four leaves, themselves pinnated, uniting upon a common footstalk. At the approach of night the leaflets all fold together; the same takes place with the partial leaves; and finally, the common footstalk bends towards the stem; at sunrise the leaves gradually unfold, and recover their usual state. So far, this is evidently the effect of light, but the same phenomena take place on touching the plant roughly, only that it recovers itself in a short period. All these motions are independent of each other, and it is possible to touch a branch so gently that it shall shrink without the leaves being affected. Some other species of *Mimosa* exhibit the same phenomena, but in a less striking degree.

**SENSORY NERVES.** See NERVE and SENSATION.

**SENSUALISM.** See PHILOSOPHY.

**SENTENCE,** in grammar, a combination of words which is complete in itself as expressing a thought or proposition, and in writing is marked at the close by a full point. It is the unit or ground-form of speech, and hence the words which combine to form a sentence are denominated *parts* of speech. A sentence must always contain two members—the *subject* or thing spoken of, and the *predicate*, or that which is enunciated regarding the subject. Accordingly every sentence must have a finite verb, though in impassioned language the verb is frequently understood. Sentences are distinguished into *simple*, *complex*, and *compound*. A simple sentence has only one subject and one finite verb, as 'The man is brave.' This may be more or less expanded by the use of adjuncts, and still retain its character of a simple sentence, unless another subject or verb is introduced, as, 'That truly patriotic man is brave beyond measure.'

If, however, the adjunct contains a verb, then we have the example of a complex sentence, as 'The man, who is truly patriotic, will risk his life for his country.' The clause here introduced to limit the idea of the subject is called a subordinate sentence. A complex sentence may accordingly be defined as a principal sentence with one or more subordinate sentences. A compound sentence consists of two or more simple sentences connected by conjunctions, as 'The sun rises in the east and sets in the west.' It differs from the complex sentence in having its clauses co-ordinate, and not, as the other, in subordination to a principal clause. A sentence, it is evident, may likewise be at the same time compound and complex, which happens when a complex clause is co-ordinated with one or more simple or complex clauses, thus giving rise to a compound complex sentence. For the division of sentences into conditional, interrogative, &c., see LOGIC—Judgments.

**SENTINEL CRAB** (*Podophthalmus vigli*), a genus of Crabs or Decapodous Crustaceans, so named from its active watchful habits, and from the very elongated footstalks upon which the eyes are set. This species, the only one of its genus, inhabits the shores of the Indian Ocean, and occurs in the Mauritius and Philippine Islands. Its average length is from 2 to 4 inches. Each eye-stalk consists of a long primary or first joint and of a short second joint. When the animal is at rest the eye-stalks are laid horizontally on the front margin of the carapace or body, and lie in two special grooves or channels. This crab is included in the family Portunidae, is further distinguished by its flat wide carapace, and by the elongated *chela* or nipping-claws.

**SENTRY,** or **SENTINEL,** a soldier set to watch or guard an army, camp, or other place from surprise, by observing and giving notice of the approach of danger. At night each sentinel is furnished with the countersign, and no one, not even the commander-in-chief, may approach or pass him without giving this preconcerted signal. Should the intruder fail to give the 'word,' it is the duty of the sentinel to arrest him, or if necessary shoot him. The punishment of a sentinel for sleeping at his post is, under martial law, death.

**SEPARATE ESTATE,** in law, is the designation of a married woman's property when held independently of the husband's interference and control. See HUSBAND AND WIFE.

**SEPARATION.** See JUDICIAL SEPARATION.

**SEPIA,** a genus of Cephalopoda or Cuttle-fishes, included in the family Sepiidae. These Cephalopods, of which the *Sepia officinalis* (see plate MOLLUSCA, fig. 24), or Common Sepia, is a typical example, belong to the Dibranchiate or 'Two-gilled' section of their class, and to the group of Decapoda or 'Ten-armed' forms. The family Sepiidae possesses an internal calcareous shell, the so-called *sepiostaire* or 'cuttle-fish bone,' so often cast up upon our southern coasts, and formerly much in repute as an antacid in medicine, and as the source of the 'pounce' once used for spreading over eroded ink-marks to form a smooth surface for the corrected writing. This cuttle-bone consists of a broad plate, convex on one side, and presenting at one extremity lateral expansions. An imperfectly chambered apex or *muco* exists. Its texture is very light and spongy, and on microscopic section the *sepiostaire* is seen to consist of horizontal layers supported on numerous intervening pillar-like supports. The suckers exist in four rows on the arms of the genus *Sepia*, and, as in all Decapodous Cuttle-fishes, the suckers are pedunculated, that is, supported on short stalks. Lateral fins exist, and these are as long as the body, which is of somewhat oblong figure. The two ten-

tacles or arms, which are longer than the remaining eight, are wide at their tips, and possess suckers at their expanded extremities only. The genera *Beloptera*, *Sepiola*, and *Spirulirostra* are also generally included in this family of Cephalopoda. The ink of the *Sepia* was long thought to form an ingredient in Chinese and Indian ink—a supposition which, from accounts given by travellers of the manufacture of these pigments, is now known to be entirely erroneous. The eggs of the *Sepia* resemble bunches of grapes in form, and hence the clusters of ova of these forms receive from fishermen and others the fanciful name of 'sea-grapes.' The eggs are each inclosed in a leathery capsule—the so-called *nidamental capsule* of these and other Mollusca, which serves to protect them. *Sepia officinalis* itself occurs on the southern English coasts, but more especially in the Mediterranean Sea. Large specimens of this genus and species appear to be occasionally developed. See also MOLLUSCA, KRAKEN, &c.

SEPIOSTAIRE. See *SEPIA*.

SEPOYS (corrupted form of *sipahi*, a soldier, from *sip*, bow or arrow, the original weapon of the Hindu soldier), the name given in India to the forces composed of natives, disciplined after the European manner. The French were the first to see that the transportation of troops from Europe to their Indian colonies would be too expensive, and that Europeans would perish in great numbers by the exposure at sea and in the climate of India. They therefore took Hindus into pay, and the English adopted the same policy. Previous to the great mutiny the army of the East India Company was composed of five or six times as many natives as Europeans; but since India has been transferred to the crown the number of native troops is not so disproportionate to that of the Europeans, being now usually about double the latter. In 1900 the total strength of the native army in India was 155,249, and that of the European was 73,638. Though not generally equal in courage and dexterity to European soldiers, the Sepoys are hardy and capable of enduring much, and very temperate in their food.

SEPTEMBER (from the Latin *septimus*, seventh), the ninth month of our year, but the seventh of the old Roman year, which began in March. It has always contained thirty days. See CALENDAR and EPOCH.

SEPTEMBRISURS, the name given to the authors and agents of the horrible massacre of prisoners in Paris on the 2d and 3d of September, 1792. Upwards of 1000, at the lowest computation, were mercilessly murdered at the hands of the frantic populace; neither age, sex, nor office was regarded, and if many of the massacred were criminals, many more were innocent.

SEPTUAGESIMA SUNDAY, the third Sunday before Lent, so called from its being about seventy days before Easter (*septuagesimus*, seventieth).

SEPTUAGINT, or the LXX., the Version of the Seventy, the Alexandrine Version, &c., is the oldest Greek version of the Old Testament. The name is generally traced back to the mythical relation of Aristeas, which met with general credence till the latter half of the seventeenth century. In a letter to his brother, Aristeas, a Greek, writes that Ptolemy Philadelphus, king of Egypt (284–247 B.C.), at whose court he pretends to be then staying, having been advised by Demetrius Phalerens, his librarian, to apply to the Jewish high-priest Eleazar for a copy of the book containing the Jewish laws, despatched a letter to Eleazar requesting seventy-two persons to act as interpreters of these laws. His request was granted, and the seventy-two interpreters retired to the island of Pharos, and there completed their trans-

lation in seventy-two days. The version was approved by a number of Jews to whom it was read, and copies of it were allowed to be taken. The account of Josephus does not vary much from that of Aristeas; but Philo's account differs in a number of circumstances. The story at a later period received numerous embellishments, and the impossibility of the narrative being authentic was clearly demonstrated by Hody, Scaliger, and others, and it is now universally pronounced fabulous. We probably owe the LXX. to some Alexandrian Jews, who, having lost the knowledge of the Hebrew, caused this translation to be made by some of their learned countrymen, for the use of the synagogues, and called it the Septuagint from the great sanhedrin of seventy-two members. It dates from the third century B.C. At first only the Pentateuch was translated; and the version of the remaining books of the Old Testament was accomplished gradually, the whole being finally completed in the second century B.C. From the varieties of style evinced in the version it is clear that there must have been several translators, though how many it is impossible to ascertain. The language of the LXX. is the Hellenistic Greek of Alexandria, based upon the Attic dialect. The most skilfully executed portion of the Septuagint is the Pentateuch, next to that the book of Proverbs. The execution of the Psalms and Prophets is very indifferent. Of the Prophets the version of Jeremiah is the best, and that of Daniel the worst. It is inferred regarding the Hebrew MS. or MSS. from which the version was made, that the letters were substantially the same as the present square characters, that there were no vowel points, no separation into words, no final letters, and that the words were frequently abbreviated. From the harmony found to subsist in a multitude of instances between the Septuagint and the Samaritan version, it has been surmised that the latter was the basis of the former; but the enmity existing between the Jews and Samaritans militates against this hypothesis. To explain the resemblance between the two versions Gesenius supposes them both to proceed from a common recension of the Hebrew Scriptures, and other hypotheses have been made, none of which are not open to objections. The Septuagint is the original of every ancient version of Scripture with the exception of the Syriac Peshito and the Samaritan. It was the sole standard of authority during the first four centuries, and has been the Bible of the Eastern Church from the first. Of 350 direct quotations in the New Testament from the Old Testament, scarcely fifty are found which differ materially from the Septuagint. It does not appear, however, to have obtained general authority so long as Hebrew was understood at Alexandria, nor can it be proved to have been commonly substituted by the Jews for the original in the synagogue service at an early period. It was, however, adopted by Philo and Josephus, and was universally received by the early Christians. In the transcription of the Septuagint, of which numerous copies were made, a great number of mistakes crept into the text. The task of rectifying it was undertaken by Origen, and the version as amended by him finds a place in his Greek Hexapla. The Septuagint is of undoubted value to the Bible critic, though the translation is not always literal, and misapprehensions of the meaning of the original are frequent. Glosses are very often inserted, and arbitrary paraphrases are numerous. There is also observable a tendency to tone down the more marked instances of anthropomorphism. The principal extant MSS. known are the Codex Alexandrinus in the British Museum, the Codex Vaticanus in Rome, and the Codex Sinaiticus (imperfect) in St. Petersburg. The principal printed

editions are the Complutensian (1517), the Roman or Sixtine (1587), the Oxford of 1707-20, the Oxford of 1798-1827 (Holmes-Parsons, five vols. folio), and the Cambridge edition by H. B. Swete (1887-94; 2nd edn., 1895-99, three vols.). The Septuagint, which had been used by Jews and Christians long after Christ, was gradually superseded by other Greek versions, such as those of Aquila, Theodotion, and Symmachus, representing more closely the Hebrew text as it latterly stood, but only small fragments of these now exist. There is a Concordance to the Septuagint by Hatch and Redpath.

**SEPULCHRAL MOUND.** See **TUMULI**.

**SEPULVEDA**, JUAN GINES DE, a Spanish theologian and historian, born about 1490 at Pozo Blanco, near Cordova. He passed three years at the University of Alcalá de Henares, and in 1515 proceeded to Italy and studied theology at Bologna. At Rome, whither he next went, he set himself to study Aristotle, and translated some of his works into Latin. He assisted Cardinal Cajetan at Naples in revising the Greek text for his edition of the New Testament, and in 1536 Charles V. appointed him his historiographer, and tutor to his son Philip. In 1557 he quitted the Spanish court, and retired to his country house at Mariano, where he died in 1574. The elegance of the style of Sepulveda has earned for him the title of the Livy of Spain. His chief work is a history of Charles V. An edition of his works was published by the Madrid Academy in 1780.

**SEQUESTRATION**, in law, the act of separating a thing in controversy from the possession of both parties, till their right to it is determined by course of law. It is either voluntary or necessary: voluntary when it is done by consent of the parties, and necessary when it takes place by order of the official authority. In Scotland sequestration corresponds to the process of bankruptcy in England. See **BANKRUPTCY**.

**SEQUIN**, a Venetian gold coin first struck about the end of the thirteenth century, and equivalent in value to about 9s. 4d. sterling.

**SEQUOIA**, a genus of evergreen coniferous trees, with two species, both confined to California. The best-known species is the so-called Mammoth Tree, *S. (Wellingtonia) gigantea*, of the Sierra Nevada. This species is found in groves along with other trees in the sheltered valleys of that range, and attains an average height of about 300 feet. The most celebrated groves are those of Calaveras and Mariposa, and one of the fallen trees in the former grove, known as the Father of the Forest, must have been over 400 feet in height. The Mother of the Forest is 327 feet high, and has a circumference of 75 feet near the base. These are among the loftiest trees in the world, being exceeded in height only by some of the eucalypti or gum-trees of Australia. The larger specimens must be older than the Christian era. The other species, *S. sempervirens*, yields a timber known as redwood. Both are now cultivated in many countries for ornamental purposes.

**SERAGLIO** (ultimately from Latin *sera*, a bolt, but in its usual meaning influenced by the Persian word *serai*), the former imperial palace of the Osmanli Sultans, in Constantinople, occupying the extreme eastern part of the city proper, at the entrance of the Bosphorus. It stands on the site of ancient Byzantium and is of great historic interest, but many of its buildings were destroyed by fire in 1863. The existing buildings date from the time of Mahmoud II., and chiefly occupy the summit of a hill, which is surrounded by fine gardens, the whole being enclosed by ruinous walls, partly of mediæval origin. The entrance is on the west, near the church of St. Sophia, by the Imperial Gate

(*Babi Humayum*, the 'Sublime Porte'), which leads into a court lined by the mint, the old church of St. Irene (now an armoury, with many interesting objects), a museum of antiquities (also of some interest), &c. Another gate, the *Orta Kapoussi*, leads from this court into an inner one, which is surrounded by arcades and the former kitchens of the sultan, his wives, and officials. The main part of the seraglio is then reached through the *Babi Saadet*, or Gate of Felicity, formerly guarded by eunuchs. Here is the Hall of the Divan, where ambassadors were formerly received, councils held, and justice administered; the treasury, with beautiful and valuable collections; and the harem, where the sultan's wives were housed. There are also kiosks and other buildings within the enclosure. Since the time of Mahmoud II. this palace has not been regularly occupied by the sultans, and it has therefore lost much of its former magnificence and interest. The word seraglio has come to denote a harem or place for the seclusion of concubines.

**SERAING**, a town of Belgium, in the province of Liège, 3 miles south-west of Liège, on the right bank of the Meuse, here crossed by a handsome suspension-bridge, communicating with Jemeppe. The very extensive iron and machine works of Cockerill, now owned by a company, employing about 11,000 hands, are established here in the old palace of the Prince-bishop of Liège, and there is also a magnificent glass and crystal work. Near the town several coal-pits are in operation, and iron ship-building is carried on. Pop. (1900), 39,623.

**SERAJEVO.** See **BOSNA-SERAJ**.

**SERAMPORE**, or **SERAMPUR**, a town of Hindustan, in Hughli District, Bengal, on the right bank of the Hughli, 12 miles above Calcutta. It extends about a mile along the banks of the river, is built in the European style, and is kept remarkably clean. Paper and mats are manufactured. It formerly belonged to the Danes, who sold it to the British government in 1845. Serampore was the headquarters of the celebrated Baptist missionaries, Carey, Marshman, and Ward; and there are a church, school, college, and library connected with the mission. Pop. (1891), 35,952.

**SERAPEUM**, the name given to various Egyptian temples dedicated to the god Serapis (q.v. see). The Serapeum at Memphis has been shown to have been the cemetery of the Apis, and close to the Apeum, where the bull dwelt while in life. Within its precincts also were the dwellings of the priests, and an hospital for the sick, who flocked here to be cured by the dreams vouchsafed them by the god. The approach to the temple from the city was through an avenue of sphinxes. The ruins of the edifice, as well as the dromos of sphinxes, which had already become partially buried in the sand in the days of Strabo, were discovered by M. Mariette in 1850. After excavating a length of 7000 feet, and uncovering 141 sphinxes, he discovered at the end of the avenue a semicircle adorned with statues of the sages, poets, and philosophers of ancient Greece, and this is supposed to have formed part of the library of the Serapeum. Near this a transverse avenue led on the right to a temple of Apis, erected by Nectanebos, and on the left to the Serapeum itself. Further excavations disclosed among other interesting objects the subterranean tombs of the mummies of the Apis. This great cemetery divided itself into two parts, the one, a vaulted gallery, containing twenty sepulchral chambers, of dates ranging from Rameses II. to Psammetichus I.; and the other, a souterrain, divided into a number of galleries, begun in the fifty-second year of Psammetichus I., and continued till the beginning of the Roman Em-

pire. The bull mummies of this division were deposited in gigantic monolith sarcophagi of Syenitic granite, sometimes as high as 12 feet, with a length of 15 feet, and weighing upwards of 60 tons. The dead bull was treated as a deceased human being, and the sarcophagi were accompanied by sepulchral vases and by the usual sepulchral figures offered to the dead. Votive tablets were placed over the lintels of the doors of the chambers, and as one of these always contained the date of the birth or discovery, the enthronement, and death or burial of the particular Apis, they have become of great importance in determining the chronology of the nineteenth and subsequent dynasties. They end with Ptolemy Euergetes II. (B.C. 177). The discovery among the ruins of 146 papyri (now in various museums) has thrown light upon the mode in which the affairs of the temple were administered, and upon other matters connected with the worship of the Apis. These papyri all date from the eighteenth to the twenty-fourth year of Ptolemy Philometor, and we learn from them that the temple was under the direction of prefects, delegates, vicars, sub-administrators, and store-keepers. Two priestesses also served Æsculapius and Serapis, and a kind of monkish order lived in celibacy and seclusion within the precincts of the temple, which they never left. A large number of bronze figures and various other antiquities were also discovered among the ruins. The tablets found numbered 1200, and altogether about 7000 objects were discovered, nearly half of them referring to the worship of the Apis. See Mariette's *Choix de Monuments decouverts pendant le déplacement du Sérapéum de Memphis* (4to, Paris, 1856); *Mémoire de la mère d'Apis* (4to, Paris, 1856); L'Athensum Français, 1855, 1856; Lepsius, *Ueber den Apiskreis*, in the *Zeitschrift der Morgenländischen Gesellschaft* (1853).

SERAPHIM (plural of *seraph*), a name applied by the prophet Isaiah to certain attendants of Jehovah in a divine vision presented to him in the temple (Isa. vi. 2). Their position is represented as being above or over Jehovah (not the throne, as in the Authorized Version); their attitude that of reverent adorers of God's holy majesty, and ready executors of his will. Very commonly by these seraphim have been understood some sort of angelic beings—*angels of fire*. The term seraphim is only used elsewhere of the serpents of the wilderness (Num. xxi. 6, 8 and Deut. viii. 15). See *CHERUBIM*.

SERAPION, an eminent physician of Alexandria, of the sect of the Empirici, flourished about the third century. He occupied himself almost exclusively with inquiries into the nature of drugs, and was a keen opponent of Hippocrates. Many of his remedies are very absurd. Among others he recommends for epilepsy the brain of the camel, the heart of the hare, the blood of the tortoise, and the excrement of the camel.

SERAPIS, or SARAPIS, an Egyptian deity whose worship was introduced into Egypt in the reign of Ptolemy I. It is related by Plutarch and Tacitus that Ptolemy having seen in a dream the image of a god, which he was ordered to remove from the place in which it stood, sent to Sinope, on the suggestion of a traveller named Sosibius, and brought thence a colossal statue, which he set up in Alexandria. It was declared to represent the god Serapis, affirmed by Manetho to be Pluto or the Jupiter of Sinope. Of the many etymologies of the name that have been suggested the correct one is now recognized to be that of Clement of Alexandria, Serapis being composed of the names Osiris and Apis, the name of Osiris having been applied to all mortals after death, and to the bull considered as a demigod. A

magnificent temple was built at Alexandria for the reception of the statue of Serapis, and this temple—the Serapeum—was the last hold of the pagans in that city after the introduction of Christianity. Another temple of this god at Memphis, beside the Apis cemetery, was discovered by Mariette in 1850. (See *SERAPEUM*.) The Egyptians themselves never acknowledged him in their pantheon, but he was the principal deity in the Greek and Roman towns, and was considered to be either Osiris, Æsculapius, Jupiter, or Pluto. Forty-two temples are said to have been erected to him in Egypt under the Ptolemies and Romans; his worship extended also to Asia Minor, and in 146 A.D. it was introduced to Rome by Antoninus Pius. The image of Serapis perished with his temple at Alexandria, which was destroyed in 380 by the order of Theodosius.

SERASKIER, or SERI-ASKER (Persian, 'head of the army'), the name given to the commanders-in-chief of the Turkish armies, and particularly to the generalissimo or minister of war. As applied in the latter sense the seraskier has very extensive powers, and is second only to the grand-vizier; he is chosen from among the pashas of two or three tails.

SERENADE (Italian, *serenata*, from the Latin *serenus*, clear), properly, music performed in a clear night; hence a musical entertainment provided by a lover under the window of his mistress. It consists generally of instrumental music, but vocal is sometimes added. The practice existed even among the Greeks and Romans. Such music is sometimes performed merely as a mark of esteem and good-will towards distinguished persons, and then is not unfrequently accompanied by long processions with torches. Hence the different character of serenades. A single singer may accompany his song with the guitar, mandoline, lute, &c.; or wind-instruments may be used, as flutes, horns, clarionets, hautboys; or, as is the fashion in some of the largest cities of Northern Germany, many singers may join. Serenades are also sometimes used as concert-pieces, and then, of course, experience some change of character.

SERES, a town in Turkey, on a height above a large and fertile plain, 35 miles north-east of Salonica. It is surrounded by embattled walls flanked with towers, is well built, and has various mosques and Greek churches, spacious bazaars, manufactures of linen and cotton goods, and a considerable trade in cotton, tobacco, corn, and fruit. Pop. about 25,000.

SERFS, a term applied to a class of labourers existing under the feudal system, and whose condition, though not exactly that of slaves, was little removed from it. The slave system, which had attained to such vast dimensions in the days of the Roman Empire, and under which the persons of the slaves were as much the marketable property of their lord as anything he possessed, was replaced, on the establishment of the barbarians upon the ruins of the empire, by a species of servitude which was so far an improvement upon the old that a certain amount of personal liberty, at least, was assured to the slave. Whatever may have been the numbers of the servile class of the community at this time, and they must have been considerable, they were afterwards largely increased as the feudal system developed itself more. Under this system, from the vassals of the king downwards, the whole community was subject to certain degrees of servitude, and it was only on condition of specific services to be rendered to his superior that any individual held his fief. In the case of the lower classes this servitude amounted to an almost complete surrender of their personal liberty. In Gaul, where the feudal system experienced its greatest development, and where serfdom became the most extensive and severe

in its application to the masses of the people, the German conquerors gave themselves up to the enjoyments of war and the chase, and to the grosser sensual pleasures, while their flocks were tended and their lands tilled by the serfs, some of whom paid rent in kind, while others stored the produce of their labours for their masters, deducting a small amount for their own subsistence. The causes that tended to the increase of this class are not far to seek. Small proprietors who could not uphold themselves in their possessions against the rapacity of their more powerful neighbours, had frequently not only to suffer the pillage of these, but along with them to surrender their own persons to be the servants of the pillagers; for how otherwise could they subsist! Famine again, which was of common occurrence in those days, obliged many freemen to sell themselves into slavery in order to save themselves from a worse fate. Others exchanged their liberty for the protection of some powerful lord; while many surrendered themselves and their properties to churches and monasteries in exchange for the spiritual blessings which they expected to derive from these institutions for so doing. Likewise offenders against the laws, when unable to pay the fines laid upon them, and persons who failed in the performance of their military duties, were reduced, or liable to be reduced, to the condition of serfs. Thus, while the condition of the original slaves underwent a marked improvement, many of the lower ranks of freemen sunk to the level to which these were raised, and some conception may thus be formed of the great numbers comprising the class we are considering. Montesquieu affirms that at the beginning of the ascendancy of the third dynasty in the tenth century nearly all the people of France were serfs. Of course the state of the serfs varied very much, and depended greatly upon the character of their masters. There were two classes of labourers—the villeins and the serfs proper. In many cases, however, the line of demarcation between these two was so ill-defined as to be scarcely distinguishable, and they gradually became more and more closely assimilated to each other. There is no doubt, however, that the distinction was real, and that the villeins occupied a middle position between freemen and serfs. (See VILLEIN.) Hallam remarks, in reference to these two classes, that 'in England, at least from the reign of Henry II., one only, and that the inferior species, existed; incapable of property and destitute of redress except against the most outrageous injuries. The lord could seize whatever they acquired or inherited, or convey them apart from the land to a stranger. Their tenure bound them to what were called villein services, ignoble in their nature and indeterminate in their degree—the felling of timber, the carrying of manure, the repairing of roads for their lord, who seems to have possessed an equally unbounded right over their labour and its fruits. But by the customs of France and Germany persons in this abject state seem to have been called serfs, and distinguished from villeins, who were only bound to fixed payments and duties in respect of their lord, though, as it seems, without any legal redress if injured by him.' 'The third estate of men,' says Beaumanoir, is that of such as are not free; and these are not all of one condition, for some are so subject to their lord that he may take all they have, alive or dead, and imprison them wherever he pleases, being accountable to none but God; while others are treated more gently, from whom the lord can take nothing but customary payments, though at their death all they have escheats to him.' One thing, however, the lord could not do with his serf—he dared not sell him; and this is mainly attributable

to the influence of the church, which denounced traffic in Christians. Children, as a rule, followed the condition of the mother; but in England, as far back as the beginning of the twelfth century, it was the father's condition that determined that of the children. As a counteractive to the rapid increase of serfs the custom of manumission, which had been so frequently practised in the days of the Romans, came again into common use; and this was also enforced as a duty by the clergy, though it does not appear that they themselves generally practised as they taught. The custom, which gradually came into operation, of allowing a serf to hold property put it into his power to purchase his freedom, and this was largely taken advantage of. Again, if a serf resided for a year and a day in a borough he became free *ipso facto*. When serfs were called out to fight, as frequently happened, especially during the progress of the Crusades, their freedom was the price of their services. By these various means the serf population through time began visibly to decrease. In some parts of Germany they almost entirely disappeared before the close of the thirteenth century; and in Italy at the beginning of the fifteenth century they are spoken of as no longer existing. The first attempt made in France for a general abolition of serfdom was that of Louis X., who published an edict in 1315, in terms of which, after pointing out that his kingdom was denominated the kingdom of the Franks, and that he wished the fact to correspond with the name, he emancipates all persons in the royal domains upon paying a just composition, as an example for other lords to follow. This edict seems, however, never to have been fully carried out, and it is a fact that predial servitude was not abolished in all parts of France till the revolution. It is true that the parliament of Toulouse, in the middle of the fifteenth century, decreed that every man who entered the kingdom crying *France* should be free; but unfortunately for the boasted freedom of the French air it had no effect in freeing those who were already upon the soil. In some parts of Prussia a modified villeinage existed till the nineteenth century. The extinction of serfdom in England was very gradual, and without any special enactment, but as late as the reign of Elizabeth we find a commission issued by that sovereign (1574) to inquire into the lands and goods of all her bondsmen and bondswomen in specified counties, in order to compound with them for their manumission, that they might enjoy all their lands and goods as freemen. Serfdom in Scotland died out by degrees, the same as in England. In Russia, where the feudal system never prevailed, serfdom was unknown until 1593, though chattel slavery had long existed there. It was introduced by Boris Godunoff, and in a few years all the rural populations were subject to it, except the inhabitants of the free communes constituting the crown domains, and many even of these were reduced to serfdom by grants made of parts of the crown domains with their population to private individuals. The Russian serf of the nineteenth century differed little from the villeins of the feudal system. One peculiarity of the Russian serf was that, while he himself was the property of his lord, the land he cultivated was his own. Various efforts were made by previous sovereigns, particularly Alexander I., to bring about the emancipation or improve the condition of the serfs; but it was not till Alexander II. ascended the throne that the system of serfdom was abolished. On March 17, 1861, the imperial manifesto emancipating the serfs, under certain conditions, was published. Two years were allowed in order to have its provisions carried completely into effect, and from March, 1863, the 20,000,000 serfs of Russia have enjoyed their

personal freedom, while they also enjoy the perpetual use of their cottages and gardens, with certain portions of land.

**SERGE**, a kind of twilled worsted cloth, used for ladies' dresses, gentlemen's summer suits, &c. Navy serge is a thick durable make of this cloth.

**SERGEANT**, in the army, is an inferior or non-commissioned officer in a company of foot or troop of dragoons appointed to see discipline observed, to teach the soldiers the exercise of their arms, and to order, straighten, and form ranks, files, &c. He also commands small bodies of men, as escorts and the like. He ranks next above the corporal, and is usually chosen from the steadiest of the corporals. There are four sergeants in a company, and of these the senior is called colour-sergeant. Staff-sergeants are higher than these, and the highest sergeant of all is the sergeant-major.

**SERGEANTY**, **GRAND** (Latin, *serviens*, serving), a tenure whereby lands in England were held of the king in feudal times in return for certain services to be rendered in person at his coronation, such as acting as his butler, champion, or other officer; or in times of war by carrying his banner, sword, or the like. It thus differed from knight-service, which required attendance upon the king in his wars only. Tenure by cornage, which was to wind a horn when the Scotch or other enemies entered the land in order to warn the king's subjects, was, like other services of the same nature, a species of grand-sergeanty.

Petty-sergeanty was applied to a tenure of land from the king by the service of rendering to him annually some small implement of war, as a bow, sword, spurs, or the like. The Blenheim and Strathfieldsaye estates, bestowed by the nation as the reward of public services, are held of the crown by this tenure, the Dukes of Marlborough and Wellington being each bound to render a small flag annually.

**SERGIPE**, or **SERGIPE-DEL-REY**, a state of Brazil, bounded north by Alagoas and Pernambuco, east by the Atlantic, and south and west by Bahia; area, 7370 square miles. The coast is generally low and sandy, but the interior gradually rises into mountains. The principal river is the São-Francisco, which flows between it and Pernambuco. The soil is not very fertile, but in many districts raises good crops of cotton, sugar-cane, manioc, tobacco, rice, &c. The chief town is Aracaju, with a population of 5000; pop. of state (1890), 310,926.

**SERIAL HOMOLOGY**. The term homology means the resemblance between parts which are constructed on the same fundamental type or plan, such as the wing of the bird, the arm of man, the fore-limb of the horse, the wing of the bat, and the paddle of the whale. The name *serial homology* has been used to express the relation existing between a series of parts belonging to one animal, and which evince a correspondence or similarity in structure. In serial homology, as in ordinary homology, we do not take the functions or uses of the parts at all into consideration, homology dealing with structure alone. In the Lobster and its allies we may see typical examples of serial homology. Each ring or joint of the tail of the Lobster may very readily be demonstrated to possess a structure exactly similar in type to its neighbour joints, and in the fore part of the animal's body, and with a little more trouble than in the case of the tail-segments, the same type or plan may be seen to prevail. These various parts undoubtedly differ in function. Some segments have appendages for swimming; others have appendages which appear as walking-legs; whilst the appendages of the head subserve mastication. But beneath these diversities of appearance the one type or plan runs through the entire series of joints constituting the

lobster's body, and hence we here find an example of 'serial homology.' In some cases the serial arrangement of parts evinces a much closer likeness than in the Lobster and its neighbours. In some other Annulosa (as for example the Millipedes or Julidae, and Centipedes or Scolopendridae, or as in the Worms themselves) each joint with its appendages not only closely resembles the other joints of the body, but its appendages are also exactly similar in most instances to those of the other segments. Such a close resemblance in function as well as in structure, besides constituting serial homology, is also known by the term *vegetative repetition of parts*, from the resemblance of such features to the regular uninterrupted succession of similar parts produced in the leaves, flowers, branches, and other parts of plants.

**SERIEMA** (*Dicholophus cristatus*, ORNITHOLOGY, Pl. V., fig. 18), a Gallatorial bird inhabiting the open grassy plains of Brazil and other parts of South America, but represented in the Argentine Republic by an allied form. It is 31 or 32 inches in length; the feathers are of a gray colour, with lighter and darker transverse markings, the head and neck being blackish-brown, the quill-feathers brown, the tail-feathers blackish-brown in the middle and white at the root and extremity. A kind of crest rises from the root of the beak, consisting of two rows of fine feathers curving backwards. The eye is sulphur-yellow, the beak and feet red. These birds are usually seen in pairs or in families of three or four, but they rarely show themselves where the herbage is long enough to hide them, as they are of a timid disposition and skilful in availing themselves of any cover. They are often heard, however, uttering their loud screeching cry, which somewhat resembles that of a bird of prey or the yelping of a young dog. Their food consists mainly of insects, but they also kill many serpents, lizards, &c., and therefore are highly esteemed by the Brazilians, it being forbidden by law to kill them. When caught young they are very easily tamed, and are kept about farms like other poultry. Their flesh is white and well tasted.

**SERIES**, in mathematics, a set of terms or magnitudes connected by the signs + and -, and differing from one another according to a certain law.  $1 + 2 + 3 + 4 + \dots + n$  is a series whose sum is  $\frac{n}{2}(n + 1)$ . This series is a simple form of *arithmetical progression*; the most general form is  $a + (a + b) + (a + 2b) + \dots + (a + (n - 1)b)$ , and the sum is  $\frac{n}{2}(2a + (n - 1)b)$ , where  $n$  is the number of terms,  $b$  is called the common difference. A *geometrical series* or *progression* is of the form  $a + ar + ar^2 + \dots + ar^{n-1}$ , and the sum of such a series is  $\frac{a(r^n - 1)}{r - 1}$ . If  $r$  is less than unity when  $n$  is very great  $r^n$  is very small, and when  $n$  is infinite  $r^n = 0$ ; therefore, when  $r$  is less than unity and  $n$  infinite, the sum of the infinite series is  $a \frac{1 - r^n}{1 - r}$  or  $\frac{a}{1 - r}$ . The terminating series  $a + ar + ar^2 + \dots + ar^{n-1}$  will be the quotient if  $a(r^n - 1)$  is divided by  $r - 1$ , by ordinary division of algebra; and in the same way the infinite series will arise when  $a$  is divided by  $(1 - r)$ . If any term of a geometrical progression be divided by the preceding term, the quotient is  $r$ ;  $r$  is therefore called the common ratio of the series. A geometrical progression is a simple example of a *recurring series*. A series is called a *recurring series* when from and after some fixed term each term is equal to the sum of a fixed number of the preceding terms, multiplied respec-

tively by certain constants. In a geometrical progression each term is equal to the preceding term multiplied by the common ratio  $r$ . Let  $u_{n-1}$  and  $u_n$  be any two successive terms of a geometrical progression considered as a recurring series, then  $u_n - r u_{n-1} = 0$ ;  $u_n$  is multiplied by unity, and  $u_{n-1}$  is multiplied by  $-r$ , to make this equation; therefore  $1-r$  is called the *scale of relation*. In the series  $2+4x+14x^2+46x^3+152x^4+\dots$  the law connecting consecutive terms is  $u_n - 3x u_{n-1} - x^2 u_{n-2} = 0$ , and the *scale of relation* is  $1-3x-x^2$ . If in this series  $x$  has such a value that the series is convergent, the sum of the series to infinity is  $\frac{2(1-x)}{1-3x-x^2}$ .

It will be seen on trial that the series arises from this fraction by algebraic division. If an infinite series is such that the sum of the first  $n$  terms cannot numerically exceed a finite quantity, however great  $n$  may be taken, the series is said to be *convergent*; a *divergent series* is such that its sum can be made greater numerically than any finite quantity by taking  $n$  large enough.

Series of various kinds may be assumed by particular devices; for example, assume—

$$1^3 + 2^3 + 3^3 + \dots + n^3 \equiv A + Bn + Cn^2 + Dn^3 + \dots (1) \\ 1^3 + 2^3 + 3^3 + \dots + n^3 + (n+1)^3 \equiv A + B(n+1) + C(n+1)^2 + D(n+1)^3 + \dots (2), \\ \text{by subtraction.} \\ (n+1)^3 \equiv (B+C+D\dots) + (2C+3D+\dots)n + (3D+\dots)n^2 + \dots$$

In this identity coefficients of  $n^3$  and higher powers on the right-hand side must equal 0; therefore coefficients such as E, F, &c., are separately equal to 0.

$$B + C + D = 1, 2C + 3D = 2, 3D = 1;$$

whence

$$B = \frac{1}{2}, C = \frac{1}{4}, \text{ and } D = \frac{1}{6}.$$

Since the identity is assumed to hold for all values of  $n$ , suppose  $n=1$ ; then, since  $B+C+D=1$ , A must be equal to 0. In this way the sum of  $n$  terms of the series  $1^3 + 2^3 + \&c.$  is found to be

$$\frac{1}{2}n + \frac{1}{4}n^2 + \frac{1}{6}n^3, \text{ or } \frac{n}{6}(n+1)(2n+1).$$

In the above examples the idea is conveyed that the numerical value of a series is more easily obtained from the sum of the series than by adding together the values of the terms found for each term separately; but in many cases the value of a function is found approximately by expanding the function as a converging series, and adding together a sufficient number of the numerical values of the terms of this series. A great many series are familiarly known to be expansions of well-known expressions; for example:—

$$a^x = 1 + (\log_e a)x + \frac{(\log_e a)^2 x^2}{2} + \frac{(\log_e a)^3 x^3}{6} + \dots$$

$$e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \dots$$

$$\log_e (1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} - \dots$$

$$\log_e (1-x) = -x - \frac{x^2}{2} - \frac{x^3}{3} - \frac{x^4}{4} - \frac{x^5}{5} - \dots$$

$$\cos a = 1 - \frac{a^2}{2} + \frac{a^4}{24} - \frac{a^6}{720} + \dots$$

$$\sin a = a - \frac{a^3}{6} + \frac{a^5}{120} - \frac{a^7}{5040} + \dots$$

The expansion of functions in series is most easily performed by an application of Taylor's theorem, which theorem is a subject of the differential calculus. The best treatment of the whole subject of series is probably that in Ohrystal's Algebra.

SERINAGUR, or KASHMIR. See SRINAGAR.

SERINAGAPATAM (properly, *Sri-ranga-pata-* Vol. XIII.

*nam*, 'city of Vishnu'), a celebrated town and fortress of Hindustan, in the state of Mysore, of which it was at one time the capital, 245 miles west by south from Madras, on an island formed by two branches of the Kaveri, about 3 miles long and 1 mile broad. The fort, a massive but unscientific structure now abandoned, stands on the western end of the island, and contains within its walls the ruins of the palace of Tippoo Saib, a mosque built by the same ruler, and an old temple. Just outside of the fort is Tippoo's graceful summer palace, now in decay. At the east end of the island, near the suburb of Ganjam, where almost all the inhabitants now reside, is the mausoleum in which Tippoo and his father Hyder Ali are buried. Cotton is manufactured in Ganjam. The fort was the work of Tippoo, assisted by French engineers, and was three times besieged by the British, first in 1791, and afterwards in 1792 and 1799. On the last occasion the fortress was carried by assault, Tippoo himself being slain while fighting desperately, together with 8000 men. The town once contained about 150,000 persons, but its population in 1891 was only 12,551.

SERGEANT-AT-ARMS, in England, one of the officers who attend the person of the sovereign to arrest individuals of distinction, &c. Two of them attend on the two houses of Parliament, and each has a deputy, their duties being to apprehend any offender, at the injunction of the house. Another of them attended the Court of Chancery, and one also waited on the lord-treasurer. On certain extraordinary occasions the Lord-mayor of London was allowed the attendance of a serjeant-at-arms.

SERGEANT-AT-LAW, in England, formerly a lawyer of the highest rank under a judge. Until 1846 serjeants had the exclusive privilege of pleading in the Court of Common Pleas, but except in the matter of precedence the barristers were put on a professional equality with them. At one time the serjeant required to be a barrister of sixteen years' standing, but latterly all the qualification necessary was that he should be a barrister. The judges in common law were always selected from the serjeants, but this monopoly was abolished by the Judicature Act, 1873. A serjeant was appointed by a writ of the crown, by recommendation of the chief-justice of the common-pleas made through the lord-chancellor.

SEROUS MEMBRANE. See MEMBRANE.

SERPENT, a musical instrument consisting of a long conical wooden tube bent in a serpentine form (whence the name), and covered with leather, having a mouthpiece like a trombone, ventages, and keys. Its compass was from B flat below the bass staff to G, the treble clef line, including every tone and semitone. The serpent was almost entirely superseded by the ophicleide. See OPICLEIDE.

SERPENT-CHARMING. This art is of great antiquity, but its practice is confined exclusively to eastern countries. Several allusions are made to it in the Bible, as Ps. lviii. 5; Eccl. x. 11; Jer. viii. 17, and also in classical writers. The power exercised by the charmers over poisonous serpents is unquestionably remarkable, and the common explanation of their innocuousness being attributable to the extraction of their fangs does not appear to be always consistent with fact. There is little doubt that the common practice of the charmers is to extract the fangs before exhibiting their feats; but we have good authority for believing that it is not unusual to dispense with this. Among others that might be referred to in support of this, Dr. Davy, in his Interior of Ceylon, as quoted in Smith's Bible Dictionary, says, speaking of the serpent-charmers, 'The ignorant vulgar believe that these men really possess a charm

by which they thus play without dread, and with impunity from danger. The more enlightened, laughing at this idea, consider the men impostors, and that in playing their tricks there is no danger to be avoided, it being removed by the abstraction of the poison fangs. The enlightened in this instance are mistaken, and the vulgar are nearer the truth in their opinion. I have examined the snakes I have seen exhibited, and have found the fangs in and uninjured. These men do possess a charm, though not a supernatural one—namely, that of confidence and courage. . . . They will play their tricks with any hooded snakes (*Naja tripudians*), whether just taken or long in confinement, but with no other kind of poisonous snakes.' The instrument usually employed in serpent-charming is a kind of flute, which is varied by whistling and the use of the voice. The effect of this medley of sounds is to entice them from their holes, and this done the serpent-charmer catches them by pinning them to the ground with a forked stick. In India and other places the art of serpent-charming is an hereditary profession, and is practised for the purpose of gaining a livelihood by administering to the amusement of the public. The usual feats of the serpent-charmers at their exhibitions is to suffer the reptiles to twine themselves round their bodies, and to cause them to go through a number of odd motions to the sound of music. Besides the evident power music has upon the serpents, they appear to be influenced in a marked degree by the eye of the charmer, who controls them by merely fixing his gaze upon them.

**SERPENT-EATER.** See **SECRETARY-BIRD.**

**SERPENTINE**, an abundant mineral, which almost invariably occurs destitute of a regular crystalline form. A few instances of crystallized serpentine, however, have been observed, and the form appears to be a right rectangular prism. The massive varieties have a granular or impalpable composition, and present red, brown, black, yellow, and gray colours, in veined, spotted, and other delineations. Fracture flat, conchoidal, or uneven; surface almost dull; lustre resinous, indistinct; streak white, acquires some lustre; translucent to opaque; sectile; hardness about that of calcareous spar; specific gravity 2.5. Serpentine is generally divided into two sub-species, the *common* and *precious* serpentine, the former of which consists of those varieties which are destitute of handsome colours, while the latter includes all such as, from the intensity and arrangement of their hues, are suited to purposes of ornament. Serpentine hardens on being exposed to the fire, and melts only (with great difficulty) on the edges. According to Jahn it consists of—

Silica, . . . . .	42.50
Magnesia, . . . . .	33.63
Alumina, . . . . .	1.00
Lime, . . . . .	0.25
Oxide of iron, . . . . .	1.50
Oxide of manganese, . . . . .	0.62
Oxide of chromium, . . . . .	0.35
Water, . . . . .	15.20

Serpentine forms mountain masses, and beds in primitive rocks, and frequently contains crystals, grains, or compound nodules of various other species. Precious serpentine, in particular, is often mixed with granular limestone. It is met with in most European countries. Serpentine is turned, on the lathe, into vases, and also worked into different ornaments.

**SERPENTS**, or **SNAKES** (*Ophidia*; see plate at **REPTILES**), an important order of the class *Reptilia*. The body in these animals is of elongated shape, and is covered by scales of horny structure. The vertebrae of the back are 'procoelous', that is, are hollow or concave in front, and convex posteriorly. A sternum or breast-bone is absent throughout the

class. (See fig. 9.) A shoulder-arch and front limbs are also wanting; a sacrum is never developed; and only in a few cases are hind-limbs represented, as in the *Python*s and in the *Tortricidae*. The ribs are always numerous, and become subservient to locomotion. The free or lower extremities of the ribs, that is, the ends which in ordinary circumstances would be attached to the breast-bone when present, are connected by muscles to the large scales or 'scuta' which protect the lower or abdominal surface of the body; and the Serpents thus progress upon the tips of the ribs, aided by the muscular contractions of the body. The ribs in some cases may exceed 300 pairs in number. The scales are developed from the *dermis*, the lower or under layer of the epidermal skin. They are covered by a delicate layer, which is cast off at intervals and renewed, and forms the 'exuvium' or moulted skin of the Snakes. In some species the head is covered by large scales or 'scuta,' which, as already mentioned, are also present on the lower aspect of the body. The lower jaw, as in all Reptiles, is a compound bone, each half being composed of several distinct pieces. The halves or 'rami' are not united by bone, as in Mammals or Birds (figs. 10 and 15), but are connected by ligamentous and muscular attachments only. This arrangement permits of the extension of the cavity of the mouth by the separation of the halves of the jaw, and these forms are therefore enabled to swallow prey of large bulk. This arrangement is further facilitated by the 'quadrate bone' (which see), or that which articulates the lower jaw with the skull, being movable, and being joined to the equally mobile portion (squamous or mastoid portion) of the temporal bone. The mouth-cavity in this way can be distended to a very great extent. The premaxillae or anterior parts of the upper jaw-bones are also generally united by ligaments only to the maxillae. The jaws are provided with hooked teeth of conical shape, ossified to the jaws, but not lodged in distinct sockets, which are useless for mastication, and are simply useful for retaining or holding the prey in the mouth. Valuable characters, of use in the distinction of species and in the classification of the group, are derived from the conformation and disposition of the teeth. Thus in the typical, non-poisonous, or innocuous Serpents, both jaws and the palate bear continuous rows of solid conical teeth (fig. 10), and the upper maxillae are immobile. In the Viperine Snakes (fig. 11), which represent most, although not all the typically venomous Serpents, simple conical teeth are absent on the upper maxillary or jaw bones, and these bones themselves are of small size, and can be moved upwards or downwards at will. The upper maxillae in these latter Snakes further bear each a so-called 'poison-fang' (c fig. 15, and d fig. 16), which consists of an elongated conical tooth perforated by a canal, which opens at the free extremity or point of the fang, and which communicates internally with the duct of the poison-gland. These fangs, termed generally 'canaliculated,' are capable of being elevated or depressed, and when at rest are concealed and protected within a special fold or cavity of the mucous or lining membrane of the mouth. Several fangs in a rudimentary condition exist at the base of the poison-fangs, and these latter take the place of the fangs when the latter are injured or destroyed. The poison-glands are situated behind and under the eyes. These structures probably correspond to one of the salivary glands, and in one species, *Callophis intestinalis*, the gland may extend as far back as the heart, being thus prolonged into the general cavity of the body. In the Viperine Snakes provided with this poison-apparatus there are usually a few teeth situated behind the poison-fangs on the superior maxillae, but

the palate, as in the harmless snakes, also bears teeth. In some poisonous serpents, however, exemplified by the Cobras (fig. 18) and Hydrophidæ (Water-snakes, fig. 19), which are included in the Colubrine section of the order, the arrangement of the teeth closely resembles that seen in the innocuous serpents; whilst in some Snakes (Suspecta) which are regarded as venomous, solid teeth are situated in front of the poison-fangs. And in other cases Snakes which are perfectly innocuous may yet possess canalculated fangs or teeth, these, however, not being in communication with any poison-secreting apparatus. The poison-gland (fig. 16) is externally invested by a strong muscular capsule, by the action of which, together with the movements of the jaws, the poison is injected from the fangs (b) into the wound made by the serpent's teeth.

As regards their internal structure the Snakes present but few points worthy of special notice in the present instance. The digestive system comprises large salivary glands, a distensible gullet, stomach, and intestine, which terminates in a cloaca—the external opening of the cloaca being transverse in conformation. A urinary bladder is absent. The heart, like that of all Reptiles save the Crocodiles, consists of three chambers only—two auricles and a ventricle, the circulation being of the mixed character distinctive of reptilian and amphibian forms. The lungs and other paired or symmetrical organs of the body generally exhibit an abortive or rudimentary condition of one of these structures. The right lung is thus generally present in an abortive and functionally useless condition; or, as in certain vipers, one lung may be absent altogether. No external ears exist. The nostrils are situated on the snout. The tongue is of double conformation, and is bifid or forked at its apex. It is generally elongated, and capable of protrusion to a great extent. A sheath-like membrane invests the base of the tongue, and into this it can be retracted at will. The function of the tongue in serpents may be probably regarded as being more intimately associated with the sense of touch than with that of taste. The eye of serpents is unprotected by eyelids, the protective functions of which structures are replaced by an anterior layer of transparent skin attached above and below to a ridge of scales which surrounds the eye. This layer, known as the 'antocular membrane,' completely covers and protects the eye, and gives to the gaze of these animals the fixed, stony character so familiar to all. The 'conjunctiva,' or front membrane of the eye, forming the familiar 'white' of the eye, is in the Serpents reflected forwards so as to form an inner lining to the antocular membrane; and a pouch or sac is thus formed between these layers of the conjunctiva, in which the secretion of the eye is retained for the purpose of keeping its surface moist. The antocular membrane, forming part of the skin-system of these animals, is exuviated or shed periodically with the rest of the skin or epidermis. The pupil of the eye in serpents is usually of rounded shape; but in some (for example, Boas and most venomous Snakes) it is represented by a mere vertical slit.

The order Ophidia is generally divided primarily into two main sections or suborders. In the Viperina, forming the first of these sections, the upper maxillæ bear two canalculated fangs and are of small size. The palate bears two rows of teeth, and the lower jaw is provided with a row on each side. The head is of triangular shape, broadest behind; and the scales covering the head are of small or ordinary size. The Viperine Snakes are further 'ovo-viviparous,' and include the typically poisonous forms. Belonging to this sub-order are the families Viperidæ

or Vipers of the Old World (figs. 11–14), and the Crotalidæ or Rattlesnakes of America (figs. 15 and 16). The Viper (*Pelias Berus*) is a familiar European snake, and represents the only venomous British snake. Its bite is not generally fatal, unless in weakly subjects. The Vipers are distinguished from the Crotalidæ by the absence of a deep pit or fossa on each side of the nose, the function of which is unknown. The Horned African Viper (*Cerastes Hasselquistii*, fig. 14), said by some to have been the 'asp' which Cleopatra used to effect her fatal purpose; the Death-adder of Australia (*Acanthopis tortor*); and the Puff-adder of Southern Africa (*Ophiophagus arietans*), are amongst the other most familiar members of this sub-order. The Crotalidæ include the Rattlesnake of North America (*Crotalus horridus*, figs. 15, 16), celebrated for the row of horny pieces or segments of pyramidal shape situated at the extremity of the tail, and from the presence of which the animal derives its familiar name. This appendage, which sounds or 'rattles' when the snake is about to strike, is believed to be used for the purpose of imitating the note of the Cicada, a hemipterous insect, and of thus attracting birds to the spot, when they are seized by the snake. It is very doubtful, however, if this explanation be correct. The number of segments in the rattle is said to increase with each change of skin.

The second sub-order, that of the Colubrina, is characterized by the larger size of the upper maxillæ, and by these bones possessing solid teeth with or without the presence of canalculated fangs. The fangs of the Colubrina are further immovably fixed in the mouth, and cannot be erected or depressed at will like those of the Viperina. The head is further of rounded shape, and not distinctly triangular; and its upper aspect is covered by *scuta* or scales of large size. The Colubrina include the typically harmless or innocuous snakes, but they are also represented by several of the most deadly species of snakes. The sub-order is divided into three sections, of which the Innocua or Harmless Colubrina form the first. The members of this group possess no fangs, the upper jaw bearing solid teeth. The Common Ringed British Snake (*Coluber natrix*, figs. 8–10); the *C. Elaphis* of Italy and Southern France; the *C. Esculapii* of Rome; the Black Snake of North America (*C. constrictor*); the Boas and Pythons (Boidæ, fig. 20) of the Old and New Worlds—terrible in their strength and size, but utterly destitute of a poison-apparatus; the Tropidonoti or Aquatic Snakes, found in North American rivers; the Heterodons of the United States; the Erycidæ of Turkey and Greece; and the Tortricidæ, form the chief examples of this section. The section Suspecta includes Colubrine Serpents, which possess canalculated fangs situated posteriorly on the upper jaws, with solid teeth in front of the fangs. These Snakes inhabit the Eastern Hemisphere exclusively, and are represented by the family Homalopsidæ, the members of which inhabit the rivers and ponds of India and the Eastern Archipelago; by the Dipsadidæ, and by the Dendrophidæ. These snakes are chiefly aquatic in habits. The last section of the Colubrina is that of the Venenosa, represented by the Cobra da Capello of India (*Naja tripudians*, fig. 18), by the Haja (*Naja Haje*) of Egypt, and by the Hydrophidæ or Water-snakes of the Indian Ocean. In these deadly species the fangs exist in front of the upper maxillæ, and possess small solid teeth behind them. The different kinds or species of Snakes will be found described in articles under their respective headings, such as NAJA, RATTLESNAKE, PYTHON, &c. See also REPTILIA. [In fig. 15, a refers to cranium, b to frontal bones, c fangs, d lower jaw; in 16, a is nostril, b fangs, c salivary

glands, & muscles of head; *e* refers to the poison gland, but the index-line should have been made to extend a little farther.]

**SERPUKHOV**, a town in Russia, in the government of Moscow, 57 miles s.s.w. of the town of Moscow, on the river Nara, near its confluence with the Oka. It consists of three distinct parts, one of which, called the Fort, is seated on a height surrounded by dilapidated walls. It has an old cathedral, and manufactures of woollens, cottons, paper, chemicals, leather, &c.; and a considerable trade by rail and river. Pop. (1893), 23,269.

**SERPULA**, a genus of Annelida or Worms, belonging to the order of Tubicolia or Tube-dwelling Worms. The *Serpula* are familiar objects of the sea-coasts, their hard white tubes of lime incrusting the rocks and stones about low-water mark in great plenty. *Serpula contortuplicata* and *S. triquetra* are familiar species. If one of these worms be dropped into clear sea-water when in a living state, the plume-like gills or branchiae with which the head-segments are provided will be seen to expand and contract with a beautifully regular and waving motion. These gill-plumes are two in number, and are fan-shaped. The tubes are of hard, limy consistence, and are never erect, but generally of twisted conformation. The worm fixes itself within its tube by means of the bristles attached to its body-segments. No eyes exist in this creature, although it is extremely sensitive to the action of light. One of the cirri or tentacles with which the head is provided is modified to form a plug-like organ, by means of which the mouth of the tube is closed when the worm has withdrawn into its habitation, which it does on the slightest appearance of danger. This operculum or stopper of the *Serpula*'s tube is interesting to naturalists from the fact that it is the only structure found in Annelides in which lime is deposited within the tissues. The tubes in *S. triquetra* are of angular or three-cornered shape.

**SERRA DA ESTRELLA** (*Mons Herminius*), a lofty range of granite mountains in Portugal, a continuation of the Spanish Sierra Gata, extending into the province of Beira. Its highest summit is 6460 feet high, and is covered with snow from October to June. The ridge contains some remarkable lakes, part of which are tepid. The mountain streams Condieira and Unhaes form fine cascades over the rocks. The scenery around is highly picturesque and very interesting.

**SERRANUS**, a genus of Teleostean Fishes, included in the family Percidæ or Perches, and distinguished by the small scales, by the teeth on the palatine bones, by the nine or eleven spines of the dorsal and three of the anal fin, and by the spiny operculum. The Ruddy Serranus or Onatalibi (*Serranus ovalis*) is an example of this genus, in which a large number of species is contained. This fish is found in the West Indian and Caribbean Seas. It is coloured red, spotted with blue markings, which are edged with black. Black spots exist at the lower jaw and on the tail.

**SERTORIUS, QUINTUS**, a distinguished Roman general, was born at Nursia, in the territory of the Sabines, in Italy, and at an early age served with reputation under Marius, against the Teutones, and in Spain. He held the office of quaestor in Cisalpine Gaul in 91 B.C., and as such showed great energy in raising troops and procuring arms for the impending Social or Maric war (90 to 88 B.C.), in which he probably held some command. In the quarrel of Marius and Sulla, Sertorius at first took no part; but in consequence of Sulla's opposition to his election as consul, he joined the party of Cinna, and thus became connected, contrary to his intention, with Marius.

After the return of Sulla from the Mithridatic war (88 B.C.) Sertorius was proscribed, and fled to Spain. Here his talents found a wide sphere of action. He endeavoured to gain the affections of the Spaniards, and to organise a force capable of resisting Sulla, who had sent a large army for the subjugation of Spain. The means of Sertorius were unequal to the conflict, and he embarked at New Carthage, passed into Africa, and took part in a war between the king of Mauritania and his subjects, on the side of the latter. Having gained several victories, and liberated the Mauritanians, he was requested by the Lusitanians, who were threatened with war by the Roman general Annus, to take command of their forces. Sertorius eagerly seized this opportunity of encountering Sulla. Invested with unlimited powers, he appeared at the head of the Lusitanians, who placed the most implicit confidence in him. Opposed to much superior forces, he displayed the talents of a skilful general, fatiguing the enemy by hasty marches, harassing them by ambuscades, attacking them in defiles, and avoiding a general engagement where he was not sure of the victory. In 79 B.C. Metellus Pius was sent out against him, but he effected nothing, and the success of the Romans was little better when Metellus was joined by Pompey in 76 B.C. Yet Sertorius, from love of his country, would have consented to submit, had the proscription against him been revoked. His fame even reached Mithridates, who offered him 3000 talents and forty ships of war on condition of his forming an alliance with him. Sertorius, who fought with reluctance against Rome, and was unwilling to see the republic humbled or enfeebled, accepted the offer on Mithridates consenting to restrict himself to the recovery of Bithynia and Cappadocia. He accordingly received the sum agreed upon, and was making preparations for pushing the war with greater vigour, when he perished by the treachery of his friends. Perperna, who had joined him in 77 B.C. with a detachment of fifty-three cohorts, formed a conspiracy against him, and assassinated him at a feast, B.C. 72. Sertorius has been made the subject of a tragedy by Corneille.

**SERTULARIA**, the scientific name of a genus of Hydrozoa or zoophytes to which, from their resemblance to miniature trees, the familiar name of 'Sea-firs' is given. The Sertularians form types of a distinct order of zoophytes (*Sertularida*) of the class Hydrozoa (= Coelenterata, which see). This order is distinguished by the fact that the *hydrosoma*, or entire compound organism constituting the zoophyte, is fixed by a definite root or *hydronisia*. The organisms consist each of several polypites or zooids, inclosed each within a cup-like structure or *hydrotheca*. The medium or *canosarc* which connects together the various members of the zoophyte-colony, and which forms, as it were, the stem and branches of this animal-tree, is generally branched in form and covered externally by a layer of horny matter. The reproductive bodies exist in the form of *gonophores*, which originate either from the *canosarc* or from special processes named *gonoblastidia*. The cups or *hydrothecæ* inclosing each of the little animals or zooids of the Sertularian Zoophytes form distinctive characters of this group. No Sertularian ever consists of but a single zooid or polypite. The mouths or openings of the hydrothecæ or cups are provided with a kind of lid or operculum, by means of which they can be closed at will. Each of the zooids in Sertularia exists as a small contractile body, provided around its free extremity or mouth with a circle of alternately-arranged tentacles furnished with the *cnidæ* or thread-cells characteristic of all Coelenterata. Sometimes the mouth may be situated on an extensible lip or proboscis-like structure, and it opens into

a chamber or body-cavity extending throughout the entire length of the polypite-body. This body-cavity opens posteriorly by a narrowed aperture into the cavity of the coenosarc, which, comparable to the hollowed stem and branches of a tree, affords a means of communication between the various connected members of the colony. Through the hollow coenosarc the products of digestion furnished by each little member of the colony are kept continually circulating. And this nutrient stream thus serves for the nourishment of the various zooids, which each contribute towards its formation and maintenance. In Sertularia itself and allied forms the reproductive buds do not become detached or separated in the form of Medusa-like bodies (as explained in the articles MEDUSIDÆ and JELLY-FISHES)—a process occurring in the reproductive history of many other zoophytes. The reproductive bodies or gonophores are inclosed, like the polypites or zooids themselves, in horny cases named *gonotheca*; and their contents simply escape (through the rupture of the gonophores) in the form of free-swimming bodies or embryos of oval shape, each of which soon settles down, attaches itself, develops a primitive polypite, which in turn, by continuous gemmation or budding, gives rise to a compound colony or organism like to that from which itself sprung.

The cells, or hydrothecæ containing the polypites or zooids, of Sertularia are arranged in an alternate manner on the branches of the coenosarc, or they may exist in pairs on the opposite sides of the coenosarc. They are sessile—that is, unstalked—or may be provided with a very short peduncle. Hincks names the order to which Sertularia belongs *Thecaphora*, from the presence of the cup-like hydrothecæ. *Sertularia fusca*, *S. cupressina*, *S. (or Diphasia) pinata*, *S. (or D.) operculata*, *S. filicula*, *S. rosea*, &c., are well-known species, which may be dredged adhering to stones, oyster-shells, and other objects, or be found at low-water mark attached to rocks and tangle-fronds. The name 'Sertularida' is derived from the Latin *sertum*, a bouquet. The Campanularida are very nearly allied to the Sertularians, and the genus Plumularia is included in the order Sertularida itself. Plumularia—of which *P. myriophyllum*, *P. cristata*, and *P. pinnata* are familiar species—have a simple or branched form of coenosarc, the cells mostly being situated in the angles of the branches; and the members of this genus possess peculiar offensive organs named *nematophores*, consisting of processes of the coenosarc abundantly supplied with thread-cells.

SERVAL, or BUSH-CAT (*Felis Serval*; see the plate at CARNIVORA), a species of Carnivorous Mammalia belonging to the family Felidae, and generally regarded as being nearly related to the Leopard and its allies. This animal inhabits South Africa, Abyssinia, Algeria, and Senegambia. Its general body-colour is a bright yellow or golden lustre, with a grayish tint. The under parts and inner aspects of the limbs are white. The fur is spotted over with black spots, which in some cases are so closely set as to form stripes. The ears are black, but exhibit a broad white band. They are very wide at the base, and form prominent objects when placed in the erect position. The average length of the Serval is about 2 feet 10 inches in length, including the tail, which attains a length of from 10 to 12 inches and is of thick and slightly bushy conformation, giving to the animal a somewhat heavy and inelegant appearance. The fur of the tail is thick and bushy. This animal appears to be of docile and even of playful disposition. It is readily domesticated. Its fur is in great request, and from its prominent markings and golden lustre obtains high prices from furrers.

The name of *Tiger-cat* is frequently applied to the Serval. The food consists of small mammals, such as monkeys and rodents, and of birds.

SERVAN, St., a town and seaport in France, on the north-west coast of the department of Ille-et-Vilaine, near the mouth of the Rance, a few hundred yards from St. Malo, from which it is separated by a narrow arm of the sea, in which there has been formed a commodious harbour. The principal buildings are the Hôtel de Ville and Collège, occupying a Capuchin monastery, founded in 1640; the Hôpital du Rosais, founded in 1712, near a mineral spring; and various administrative and other buildings. The tower of Solidor, above 60 feet high, on a cliff at the mouth of the Rance, is a well-preserved monument of the second half of the fourteenth century. The principal manufactures are cables, cordage, and ship biscuits. There are also breweries, oil-mills, ship-building yards, &c. Pop. (1896), 12,240.

SERVANT. See MASTER and SERVANT.

SERVETUS, MICHAEL (properly MIGUEL SERVEDE), a learned Spaniard, memorable as a victim of religious intolerance, was born in 1511 at Tudela, in Navarre. He was the son of a notary, who sent him to Toulouse for the study of the civil law. Excited by the discussions of the Reformers in that city, he began to give his attention to theology, and having formed views of the trinity antagonistic to the orthodox doctrine, removed to Germany, that he might have liberty to elaborate them, and there printed a tract, entitled *De Trinitatis Erroribus* (1531), which production was followed the next year by his *Dialogorum de Trinitate Libri duo*, on the subject. But he found that the expression of his opinions was as obnoxious in Germany as it would have been in France, and he therefore made his escape to France, under the name of Michael of Villa Nueva. His circumstances being depressed he engaged for some time with the Frellons, booksellers of Lyons, as corrector of the press. He then went to Paris, where he studied physic, and graduated as doctor. At Paris Servetus met Calvin for the first time, and after several meetings an arrangement was made for a theological discussion between them, but Servetus failed to appear. Soon after he quarrelled with the medical faculty at Paris, and quitted the city (1558). He first repaired to Charlien, near Lyons, where he practised three years, whence, at the instance of the Archbishop of Vienne, he removed to the latter city. It has been alleged that during this time he was in constant correspondence with Calvin, with whom he discussed points of controversy, consulting him in respect to his Arian views, and that Calvin afterwards produced his letters against him. This, however, is a mistake. The only communication which had ever taken place between them was on the occasion above mentioned. In 1558 Servetus published his matured theological system, without his name, under the title of *Christianismi Restitutio*. The magistrates of Vienne ascertained the name of the author, and Servetus was committed to prison, whence he contrived to escape, and thereby avoided that fate from Catholic hands which he was soon after to suffer from those of the Reformers. Purposing to proceed to Naples he imprudently took his way through Geneva, where he was apprehended by the magistrates on a charge of blasphemy and heresy, advanced against him by a person who had been a servant in Calvin's family. In order to insure his condemnation his various writings were sifted for accusations, and as a proof of the length to which this was carried, it may be mentioned that one of the charges against him was extracted from his edition of Ptolemy's Geography, in which he asserted that Judea had been falsely extolled for its beauty and

fertility, modern travellers having found it both sterile and unsightly. The magistrates of Geneva were, however, aware that many eyes were on them in respect to this extraordinary treatment of a person who was neither a subject nor a resident, but, properly speaking, a traveller kidnapped in his passage. They thought proper, therefore, to consult the magistrates of all the Protestant Swiss cantons, who, referring the matter to their divines, the latter unanimously declared for his punishment, Calvin being especially urgent and emphatic as to the necessity of putting him to death. As he refused to retract his opinions, he was condemned to the flames, which sentence was carried out on the 27th of October, 1553, in the forty-fourth year of his age. Servetus is numbered among the anatomists who made the nearest approach to the doctrine of the circulation of the blood, as appears from a passage in his *De Restitutione Christianismi*. The Life of Servetus has been written by several writers.

**SERVIA** (Slavonic, *Serbia*; Turkish, *Syryp*), an independent kingdom in Europe, forming anciently a part of *Moesia*, and till recently a portion of the Turkish dominions; bounded north by Hungary, from which it is separated by the Save and the Danube; east by *Walachia* (from which it is separated by the Danube) and *Bulgaria*; south by Turkey; and west by *Bosnia*, from which it is separated on the greater part of this frontier by the *Drin*. The area is 19,050 square miles, and the population, according to the census of 1884, was 1,901,736; according to that of 31st December, 1900, it was 2,493,770. The inhabitants are chiefly Servians, but include a considerable number of Roumanians and Gypsies. The surface has a general slope towards the north, and is on the whole mountainous, being traversed by ramifications of three great mountain chains—those of the Carpathians in the north-east, of the Balkan in the south-east, and of the Dinaric Alps in the west. The summits are of no great height, however, and seldom exceed 3000 feet. The whole surface belongs to the basin of the Danube, which receives the drainage partly directly and partly by the frontier river Save, augmented by the *Drin* and the *Timok*, but most of all by the *Morava*, which, besides flowing in a main stream from the centre of the principality north to the Danube, receives two larger branches under the names of the East and West *Morava*, and is fed by numerous affluents in the whole line of its course. The climate of *Servia* is somewhat rigorous in the more mountainous parts, but very mild in the valleys and plains, especially those open to the south and sheltered by hills in the north. Vegetation is vigorous, both in the mountainous districts and in the lower grounds, the former being generally covered with forests of excellent timber-trees, among which, where the elevation is not very great, the walnut is conspicuous, and the latter being generally covered with a fertile soil, well adapted for various fruits and cereals, plums in particular among the former. The principal agricultural products are maize, wheat, rye, barley, oats, hemp, flax, and tobacco. Wine is grown in the districts adjoining Hungary. Large numbers of cattle, sheep, and pigs are reared. The minerals include copper, lead, iron, and coal. The first occurs particularly in the north-east; the second occurs also chiefly in the north-east, at *Tanda* and *Lonka*, but it has been partially worked also in the west and south-west; iron is pretty generally diffused, but is not in many places workable. Manufacturing industries can scarcely be said to exist, although in quite recent times government has done much to encourage them. Trade is chiefly carried on with Austria. The chief exports are cereals, dried plums, and live stock, including

hogs. The imports of the kingdom amounted in 1900 to £2,161,000, and the exports to £2,661,000. The railways of *Servia* have a length of 364 miles. There are 2550 miles of telegraph. *Servia* has introduced the French decimal system for its monies, weights, and measures, the *dinar* being equal to one franc, and the gold *milan* to French pieces of 20 francs; but the old Turkish and Austrian weights and measures are still to some extent in use. The Servians are Slavonians by race, and the great majority of the inhabitants adhere to the Greek Church. According to the census taken in 1891 there were 16,764 Mohammedans, 11,596 Roman Catholics, 1149 Protestants, and 4652 Jews. In 1894 King Alexander revoked the constitution granted in 1889, replacing it by the older constitution of 1869, but several important modifications were introduced in April, 1901. The executive authority is vested in the king, who is assisted by a council of eight ministers with special departments. In legislation the king has to act through and with the national assembly, known as *Skupština*, and the senate. The latter consists of fifty-one members, comprising the heir-apparent, the primate of *Servia*, the Bishop of *Nish*, thirty nominated life-members, and eighteen elected members. The *Skupština* consists of 130 members, all elected by the people. An elected member of the senate must be at least forty years old and must pay an annual tax of 200 dinars. Every Servian of not less than twenty-one years of age who pays direct taxes to the amount of 45 dinars per annum is entitled to vote in the senatorial elections. Thirty is the minimum age for deputies, and the minimum annual tax is 60 dinars. The right to vote for deputies belongs to all Servians of at least twenty-one years old, paying 15 francs annually in direct taxes. The principal source of revenue in *Servia* is a proportional capitation tax. The estimated revenue in 1901 was £2,960,000, and the expenditure was just under that amount. The public debt in 1900 amounted to £16,900,000. In virtue of the law of 1886, amended by one in 1896, military service is obligatory. The peace strength of the army is about 22,500, and the effective war strength 353,000. The country is divided for administrative purposes into seventeen departments, one of them being the town of *Belgrade*.

In ancient times *Servia* was inhabited by Thracian tribes, and in the reign of Augustus was subdued by the Romans. From the time of the formation of the province of *Moesia* (probably in the reign of *Tiberius*) it belonged to this province, and when *Moesia* was afterwards divided into Upper and Lower, *Servia* belonged to the former. At the migration of nations this territory was occupied in succession by Huns, Ostrogoths, Lombards, and other tribes. In the beginning of the seventh century the Avars obtained possession of it, and against these the Emperor *Heraclius* called in the aid of the Servians, a Slavonic people then dwelling in Eastern Galicia. About the middle of the seventh century the Servians succeeded in driving out the Avars, whereupon they spread themselves over the modern *Montenegro*, the greater part of *Bosnia*, and the western half of *Servia*. An attempt was made by *Heraclius* to convert the Servians to Christianity, but their conversion was not accomplished till about the middle of the ninth century through missionaries sent out by the Emperor *Basilius*. In the ninth century *Budimir*, the first Christian prince, divided the country into several provinces. One of them, *Bosnia*, afterwards withdrew from the general government, and eventually came into subjection to Hungary, though it

retained its own rulers. Till the beginning of the eleventh century the Servians were constantly involved in wars with the neighbouring kingdom of the Bulgarians, and after the destruction of that kingdom by the Emperor Basilus II. their own land was completely reduced for a time to the condition of a Byzantine province. But before the expiration of the eleventh century they had again made themselves independent, and one of their princes, Michael, had got himself recognized by Pope Gregory VII. Internal disorders and foreign wars exhausted the land during the next century till about 1165 Stephen Nemanya raised himself to the sovereignty and founded a dynasty, which from its capital, Rassa, took the name of Rascian, and which has in some parts preserved the designation of Raizen or Rascians for the Servians to this day. He and his successors extended the dominion of the Servians on several occasions until under Stephen Dushan (1336-56) it included all Macedonia, Albania, Thessaly, Northern Greece, and Bulgaria. He assumed the title of tsar, and distributed the Empire of Servia into several governments; but he thus prepared the way for its fall and subsequent dissolution. Under his son and successor, Urosh V., the last of the dynasty of Nemanya, many of the conquered provinces were lost through internal disorders. About 1374 a new dynasty ascended the throne in the person of Lazar I., who at first reigned with success, but finally fell into the hands of the Turks at the battle of Kossova (in Albania) in 1389, and was put to death by his captors. The sultan Bajazet divided Servia between Stephen, son of Lazar, the last ruler, and his son-in-law, Vuk Brankovich. Both were compelled to pay tribute to him. Servia now became the chief theatre of the unhappy wars between the kings of Hungary and the Porte. About the middle of the fifteenth century Servia was deprived even of that form of independence which had hitherto been allowed it, and became in name, as it had long been in reality, a Turkish province. The fortress of Belgrade, however, strong in its natural position, and the readiness with which it could receive succour from Hungary, held out till 1522, when it fell before the arms of Solyman the Great. For nearly 200 years the Turks remained uninterruptedly masters of this fortress. At the end of that time the successes of Eugene procured for Austria at the Peace of Passarowitz in 1718 the largest part of Servia, with the capital, Belgrade. But by the Peace of Belgrade in 1739 Austria again lost all this territory, and it was transferred to Turkey. The barbarity of the Turkish governors and the arrogance of the janizaries led to an insurrection in 1804. George Petrovich, a man of courage, known by the name of *Czerny* or *Kara George* (that is, Black George), placed himself at the head of the malcontents. Czerny George, taking advantage of the weakness of Turkey, demanded that Servia, like Moldavia and Walachia, should be elevated to a principality under a Greek hospodar. The demand was rejected. After the Servians had gained some successes over the Turks Russia declared in their favour, and a Russian army marched into Moldavia to their aid. Supplied by the Russians with warlike stores, particularly with cannon and engineers, Czerny George took Belgrade in December, 1806, and gained other successes. After eight years of fighting with various fortune, but on the whole making continual progress towards his end, Czerny George succeeded in securing the independence of his country by the Peace of Bucharest, May 28, 1812. It was agreed in the conditions of the peace that the Porte should treat the Servians with kindness and grant them a full amnesty. The fortresses erected by them in their country during the late war were

to be demolished, and the remainder to be put into the hands of the Turks. The administration of its internal affairs was committed to the nation. The Servians were to enjoy the same advantages with the Turkish subjects in the islands of the Archipelago and in other countries. At the end of July, 1812, the Russian troops left Servia. But the war between Servia and the Porte began anew in July, 1813, and after it had continued nearly four months the Turks prevailed. Czerny George and his adherents fled to the neighbouring states. The conquerors treated those who remained with the greatest cruelty. The country was made a desert. Finally, under the conduct of Milosh all Servia rose in arms in April, 1815, and after a successful war an informal sort of convention was concluded in 1816 with the Pasha of Belgrade, and though this convention was not ratified by the Porte it was in fact followed by a state of peace. The Turks remained in possession of the fortresses, but complete self-government was allowed to the Servians, and in the sitting of the *skupstina* of 6th November, 1817, Milosh was elected prince of the land, and the rank declared hereditary in his family. The right of self-government was at length formally recognized by the Porte in the Convention of Akkerman in 1826 and the Treaty of Adrianople in 1829, and by the *hatti-sherif* or Rescript of 1830 the relations between the Porte and the principality were fixed. The internal administration was in virtue of that document entirely intrusted to the native authorities, who were, however, to acknowledge the suzerainty of the Porte, and the title and dignity of prince were recognized as hereditary in the family of Milosh. In 1839 Milosh found himself compelled to abdicate in consequence of the unpopularity into which he had fallen. He was nominally succeeded by his eldest son, Milan, who died almost immediately after, leaving the throne vacant for his younger brother, Michael. But only three years later (1842) this prince was compelled to follow the example of his father and quit the land. The Servians then elected in his room Alexander Kara-Georgevich, the son of Czerny George, and this proceeding was sanctioned by the Porte. For a short time the reign of Prince Alexander appears to have been popular, and the country made considerable progress under him; but at last the suspicion of undue dependence upon Austria destroyed this popularity, and in December, 1858, he also was forced to abdicate. During his reign the Crimean war had taken place, but the Treaty of Paris made no essential alteration in the position of the principality with reference to Turkey. After the forced abdication of Alexander, the old prince, Milosh, was then recalled, but survived his restoration little more than a year. His son, Michael, was then once more elevated to the throne (1860), but was assassinated on the 10th of June, 1868, by some of the adherents of Prince Alexander. The rising in favour of that prince that was expected to follow the deed was prevented by the prompt measures of the government, which had besides the support of the great body of the people. Michael died childless, and the princely dignity was then conferred on the recent ruler, Milan (born 1854), grand-nephew of Milosh, the founder of the dynasty. Prince Milan was then a minor, but was proclaimed major on the 22nd of August, 1872. In July, 1876, Servia joined Montenegro in declaring war on Turkey, which had been nearly a year engaged in trying to quell an insurrection in Bosnia and Herzegovina. After the fall of Plevna in the Russo-Turkish war of 1877-78 Servia again took up arms against Turkey, and by the treaty of Berlin, 18th July, 1878, it obtained an accession of territory, and the recognition of its independence. It was erected into a kingdom in 1882.

In 1885 a brief war took place between Servia and Bulgaria, in which the former was defeated. In 1889 Milan abdicated in favour of his son, Prince Alexander, born 14th August, 1876, who has since been recognized as the reigning sovereign under the title of Alexander I.

*Servian Language and Literature.*—The Servian language, formerly often called the *Illyrian*, is a Slavonic dialect, and among all the southern Slavonic idioms the softest and most melodious. It is spoken not only throughout Servia but also by the Herzegovinians and Montenegrins, as well as by the people of Bosnia, Austrian Slavonia, and Dalmatia, the Hungarian Servians, and the Croatsians. It is closely allied to the Bulgarian and Slovenian, and forms with them the southern Slavonian group. The Servians belonging to the Greek Church use the Cyrillian alphabet, those belonging to the Roman Catholic Church (Croatsians and Dalmatians) now use the Roman. The Glagol or Glagolitz alphabet was formerly largely used in Dalmatia and Croatia, but is now almost completely obsolete. Recently the Servian has been more cultivated. In 1814 Vuk Stephanovich published in Vienna a Servian grammar (translated into German, with a preface by J. Grimm and remarks by Vater, Berlin, 1824). In 1819 he published his Dictionary of the Servian Language, with German and Latin Definitions, containing above 30,000 Words in Common Use (second edition, 1852). In the Servian poetry, the excellence of which Goethe and Grimm have acknowledged, a Slavonic character of rude energy is united with an oriental warmth. In 1823 Vuk Stephanovich published three volumes of Servian poetry at Leipzig, which have been translated into German. Some of the songs are uncommonly fine. In 1826 he published *Danica* (that is, Morning Star), an annual for ladies, in Servian. Not unimportant publications in Servian literature are Simeon Milutinovich's *Serbianka*, a series of Servian heroic songs, which celebrate the insurrection of Servia, of which he was an eye-witness (four vols. 12mo, Leipzig, 1827), and two Servian translations of Horace's *Arte poetica* (Vienna, 1827), in hexameters, and in the heroic measure of the Servians. See also Kapper, *Volkalieder der Serben* (two parts, Leipzig, 1852). Servian prose literature has produced little besides theological and religious works. In fact, the literary dialect is not yet settled: the Servian scholars are not agreed whether the artificial book language, formed after the ecclesiastical Slavonic, and which has been in use for almost four centuries, or the common dialect of the country, shall become the language of literature. See Bowring's *Servian Popular Poetry* (London, 1827).

**SERVICE-BOOKS.** See **LITURGY**.

**SERVICE-TREE** (*Pyrus domestica*; natural order, Rosaceæ; sub-order, Pomææ), a pretty large European tree, closely allied to the apple and pear, but easily distinguishable by its pinnated leaves. The flowers are numerous, disposed in panicles at the extremities of the branches, and are succeeded by very small rounded or pear-shaped fruit. This fruit is excessively austere and astringent before perfect maturity, is little esteemed, and difficult of digestion, but, notwithstanding, is sometimes eaten when in a state of incipient decay. The tree attains the height of 40 or 50 feet, but the growth is exceedingly slow, the trunk hardly acquiring the diameter of 1 foot in a century. The wood is very hard, compact, solid, fine-grained, and susceptible of a brilliant polish. It is in great request among turners and cabinet-makers, and is very dear, especially the larger pieces. The service-tree grows wild in most parts of Europe, and is, besides, occasionally cultivated.—The mountain-ash is a second species of *Pyrus*. (See **ROWAN-TREE**.) In

the northern parts of the United States there is a species of *Pyrus* (*P. Americana*) closely resembling the mountain-ash, and also frequently cultivated in European gardens. It is found wild as far south as lat. 48°, and is frequent in Canada.

**SERVITES**, or **SERVANTS OF THE HOLY VIRGIN**, a religious order founded at Florence about 1233. It first obtained recognition and sanction from Pope Alexander IV. (1254–61), and from Martin V. (1417–31) it received the privileges of the mendicant orders, but never had much influence in the church. (See **ORDERS, RELIGIOUS**.) The monks were also called Brethren of the Ave Maria, because they always began their conversation with the words of the angelic greeting, and Brethren of the Passion of Christ. They follow the rule of St. Augustine. The order spread to France, the Netherlands, Germany, Poland, and Hungary, but it now numbers few members except in Italy and Germany. In 1598 Bernardino Ricciolini restored the old severity of the order, and his followers received the name of *Servites-Eremites*. Their general has the fifth place among those of the mendicant orders at Rome. Paul Sarpi and Ferrarius belonged to this order. An order of *Servite nuns* was founded about the close of the thirteenth century, and was introduced into all the countries into which the order of monks had spread, but the order now possesses only a few convents.

**SERVITUDE**, in Scotch law, is the right to the use of a thing, without property in the same, for all or for some particular purposes; or to prevent another from doing something on his property that he would otherwise be entitled to do. The former kind of servitude is called affirmative, and includes such rights as that of gathering fruit from an estate; and the latter is called negative, in virtue of which a person may be entitled to prevent the owner of a property from building walls beyond a certain height, from blocking up a window, &c. This right may either be limited to a particular person, or so connected with real property (the dominant property) that the owner of the same (the dominant owner), whoever he may be, may exercise his right upon the servient owner or owner of the estate subjected to the servitude (the servient property). In the former case the servitude is called personal; in the latter predial. The only personal servitude in Scotch law is life-rent, including the two legal life-rents, courtesy and terce. Predial servitudes are divided into servitudes on tenements (urban servitudes) and servitudes on land, including those on fields, inclosures, &c., whether in the town or country (rustic servitudes). A positive servitude can be established either by grant or by prescription; a negative servitude only by grant. In the former case the grant must be followed by possession on the part of the dominant proprietor, and this is either actual, consisting in the exercise of the right conferred; or civil, consisting in the recording of a sasine containing the grant. To complete the right it must be used for a term of years. In the latter case the grant alone is enough to complete the right, since in this case the dominant proprietor can exercise his servitude only in the event of the servient proprietor offering to violate it. Servitude may be extinguished in four ways: first, by confusion, that is, by the owner of the servient property becoming owner also of the dominant property (but according to some jurists this would only cause a suspension of the servitude as long as the properties remained united); secondly, by remuneration; thirdly, by extinction of either the servient or dominant tenement, or by such a change of circumstances as would prevent the dominant proprietor from exercising his right; and fourthly,

by prescription, or by long neglect of the right which the servitude confers. Servitudes being burdens upon an estate, the usufructuary must respect the rights of the owner of the same, and use his own rights *civiliter*, that is, with as little injury to the former as possible. On the other hand, the servient proprietor must do nothing that would affect injuriously the rights of the dominant proprietor.

**SERVIUS TULLIUS**, the sixth King of Rome. According to the tradition he was the son of a slave, given by the elder Tarquin to Tanaquil, his wife. Young Servius was educated in the palace of the monarch, and raised himself to so much consequence that Tarquin gave him his daughter in marriage. Servius became the favourite of the people and the darling of the soldiers, and was raised to the throne on the death of his father-in-law (578 B.C. according to the usual chronology). He defeated the Veientes and the Tuscans, established the census, and divided the urban and rural population of Rome by districts into tribes, instituting at the same time the *comitia centuriata* and *tributa*; he also beautified the city, and enlarged its boundaries by taking within its walls the hills Quirinalis, Viminalis, and Esquilinus. He also built several temples. Servius married his two daughters to the grandsons of his father-in-law; the elder to Tarquin, and the younger to Aruns. The wife of Aruns murdered her own husband to unite herself to Tarquin, who had assassinated his wife. Servius was then murdered by Tarquin, and his own daughter Tullia ordered her chariot to be driven over the mangled body of her father (534 B.C.) Such is the history of Servius as commonly related. But see Niebuhr's Roman History in the chapters On the Legend of Tarquinius Priscus and Servius Tullius, and Critical Examination of the History of Tarquin and Servius. See also **ROME** (History), **CENSUS**, **CENTURY**, and **COMITIA**.

**SERVUS SERVORUM DEI** (*Servant of the Servants of God*), the title which the popes give themselves. It was used by the Roman pontiffs at a very early period, although Paulus Diaconus states that Gregory the Great (590-604) was the first to adopt it.

**SESAMUM** (*S. orientale*; natural order Pedaliaceae), a plant known from a very ancient period, and very interesting on account of the economical purposes to which it is applied. It was originally brought from India, and is said to grow wild in Ceylon and along the coast of Malabar. It is called *semsem* in Egypt and other parts of the East, where it is cultivated extensively on account of the seeds (called *teel* seeds) and an oil (sometimes used under the name of *gingelly* oil) which they yield, not unlike or inferior to the oil of almonds. This plant was introduced into Carolina from Africa by the negroes, and succeeds there perfectly. It is called *bene* or *bonny*. The oil will keep many years, does not acquire any rancid smell or taste, but, on the other hand, in two years becomes quite mild, and is a good substitute for olive-oil. The negroes use the seeds as an aliment. The sesamum was introduced into Jamaica by the Jews, and is now cultivated in most parts of the island. It is called *vanglo* or *oil plant*; and the seeds are frequently used in broths by many of the Europeans, but the Jews make them chiefly into cakes. In Japan, China, and Cochinchina, where they have no butter, they use the oil for frying fish and in dressing other dishes, as a varnish, and medicinally as a resolvent and emollient. Pliny speaks of this oil as equally good to eat and burn. Nine pounds of the seed yield upwards of 2 lbs. of oil. The plant grows to the height of 2 feet or more; the stem is upright, herbaceous, hairy, and almost cylindrical; the leaves are oval-oblong, the inferior

ones opposite, with long leaf-stalks, entire, or with some very distant teeth; the superior much narrower, entire, acuminate, almost alternate, and nearly sessile; the flowers are solitary, axillary, and the corolla is white, and resembles in form that of the foxglove. —*S. Indicum* is another species cultivated in Egypt, and used for the same purposes as the preceding.

**SESOSTRIS**, a name given by the Greeks to an Egyptian king, who is not mentioned by that name on the monuments, and whose career cannot be exactly identified with any one Egyptian monarch. The prevalent opinion among Egyptian students appears to be that he is in the main identical with Ramses II., the son of Seti (the Sethos of Manetho), and the third king of the nineteenth dynasty. The name of Sesostris is explained as a corruption of Sestesura, the popular appellation of this Ramses, or of Sethosis (written by Pliny Sesothis), meaning son of Sethos, by which name the same monarch is designated in Manetho. Others think that the Greek Sesostris may be a corruption of Sesortesen or some similar form, which is the name of one king of the third dynasty and three others of the twelfth. The Sesortesen of the third dynasty is called Sesostris by Aristotle. The identification of Sesostris with Ramses II. has the support of Champollion, Salvolini, and others, but is combated by Bunsen on the ground that some of the most striking achievements attributed by Herodotus and Diodorus to Sesostris do not belong to that Ramses. Such are the victorious expeditions into Nubia and Thrace, the immense development under him of the Egyptian navy, the division of the land and its subjection to heavy burdens. But it is generally admitted that the exploits of various monarchs were united by the Greeks in their accounts of the reign of Sesostris, which contain a number of fables in addition, so that it is needless, as already stated, to seek for complete correspondence between these accounts and the monumental records of any single reign. Many of the most remarkable deeds of Sesostris may be assigned with great probability to Ramses III., the founder of the twentieth dynasty and the restorer of the power and glory of Egypt. He triumphed over the confederations formed against him by various Libyan tribes; annihilated by a great victory gained in Northern Syria a league of the Hittites, Philistines, and other Canaanitish peoples, and of tribes inhabiting the isles of the Mediterranean, in which sea he maintained a large fleet to support his operations on land.

**SESSA**, a town in Italy, Naples, in the province of Terra di Lavoro, 17 miles east of Gaeta. It is the see of a bishop, has a handsome cathedral, a seminary, hospital, and a very important weekly market. It was founded by the Ausoni-Aurunci, and afterwards became a flourishing Roman colony, under the name of Suessa-Aurunca. Numerous Roman remains (of aqueducts, baths, theatre, &c.) still exist in the town. Pop. 6180.

**SESSION**, **COURT OF**, also called the **COLLEGE OF JUSTICE**, the highest civil judicatory in Scotland. It was established by James V. in 1532 to supply the place of an ambulatory committee of Parliament, called the lords of council and session. It consisted of fourteen judges and a president; but in 1807, for the despatch of business, the court was divided into two houses, an inner and an outer, the one consisting of eight, and the other of seven judges. By 1 Will. IV. cap. lxi. the total number of judges in the Court of Session was reduced to thirteen, two being taken from the outer house. The inner house sits in two divisions, the lord-president, who is president of the whole court, and three lords-ordinary sitting in the first division, and the lord justice-clerk and

other three lords-ordinary sitting in the second division. The judges of the outer house hear causes singly. Except with certain kinds of causes all the business of the inner house comes through the outer house, and is referred to the division to which it properly belongs. When the judges of either division are equally divided in opinion they may reserve the cause for subsequent discussion, or they may direct it to be heard before the inner-house judges of both divisions, or before the whole court, including the judges of the outer house. Act 2 Will. IV. cap. v. makes provision for carrying on the business in case of the death or illness of one of the judges. Judges of the Court of Session are appointed by the crown *ad vitam aut culpam*. There lies an appeal from the Court of Session to the House of Lords. In 1815 trial by jury in civil cases was introduced, and conducted before a court called the jury court, presided over by a lord chief-commissioner. This court in a few years was abolished, and these trials are now carried on under the direction of the Court of Session. The Court of Exchequer, which consisted once of five barons, was first reduced to three, and is now abolished; one lord of session has to devote one day of the week to the trial of causes belonging to its jurisdiction. The consistory and the admiralty courts have been abolished, and their jurisdiction transferred to the Court of Session.

SESSIONS. See QUARTER SESSIONS.

SESTERTIUM. See SESTERTIUS.

SESTERTIUS, an ancient Roman silver coin (later also of a species of brass called *aurichalcum*) worth 2½ asses (hence the name *sestertius*, the third a half). The *sestertius* was the fourth part of a denarius, and when in later times the weight of the as was reduced, and 16 asses were reckoned to a denarius, the *sestertius* still retained the same proportion to the latter coin, and thus became equal to 4 asses. The value of the *sestertius* therefore varied with that of the denarius. About the close of the republic, when the denarius is calculated to have been worth about 8½d., the *sestertius* would be worth 2½d.; and under the empire, with the denarius at 7½d., the *sestertius* would be equal to 1½d. The neuter form *sestertium* denotes a much larger amount. It generally appears in the plural, and signifies not a real coin, but a sum of 1000 *sestertii*, and was therefore equivalent, according to the first reckoning of the *sestertius*, to £8, 17s., and according to the second to £7, 16s. 3d. The *sestertius* was the unit most commonly employed by the Romans in reckoning large sums of money. For sums below 1,000,000 *sestertii* the ordinary cardinal numerals were used with *sestertii* or *sestertia*, as the case might be; but if the sum amounted to 1,000,000 or more a numeral in *ies*, after which *centena millia* (100,000) had to be understood, was connected with *sestertium* (for example, *quadragies sestertium* is 4,000,000 of *sestertii*, that is, *quadragies centena millia sestertiorum nummorum*). Sometimes the numeral adverb was used alone, and *decies ei dedit* signifies *decies sestertium*, that is, *decies centena millia sestertiorum*, or 1,000,000. The *sestertius* was often expressed by the symbol HS, which is explained as a corruption either of IIS, that is, II., the numeral two, and S for *semis*, half, or of LLS, for *libra libra semis*, an as having been originally equivalent to a libra or pound.

SESTETTO, a musical piece for six independent instruments or voices. The former is particularly used for wind-instruments, and often employed for serenades or *notturni*. Moscheles, Beethoven, and others have composed *sestetti* for wind and stringed instruments. Vocal *sestetti* are used in operas; and that of Mozart, in the second act of Don Giovanni, is celebrated.

SESTINI, DOMENICO, the most learned numismatist of Europe in regard to ancient coins, as far as the knowledge of them can be acquired by inspection, born at Florence in 1750; died there in 1832. After having completed his studies at the school of San Marco he entered the clerical order; but in 1774 he left his native city, and visited Rome, Naples, and Sicily. In Sicily he received from Prince Biscari the commission to arrange his museum at Catania, and from this time he applied himself exclusively to numismatic studies. In order to prosecute his studies with more effect he went from Sicily through Malta and Smyrna to Constantinople, where he prepared his observations on the plague, which then prevailed. The British ambassador at the Porte, Sir Robert Ainslie, was then forming a collection of ancient coins. Sestini became his agent, and in the course of his travels, which extended as far as Bushire on the Persian Gulf, collected the celebrated cabinet which he has described in his *Lettere e Dissertazioni numismatiche sopra alcune Medaglie rare della Collezione Ainslieana* (four vols. 1789-90, 4to). To perfect his knowledge of ancient coins he travelled through Germany, visited Gotha, Dresden, and Berlin, where he settled, and was appointed by the king superintendent of the collection there. In 1810 he went to Paris, where he was elected a corresponding member of the Académie des Inscriptions et Belles Lettres, and two years later he received the appointment of antiquary and librarian of the Princess Eliza (sister of Napoleon), then Grand-duchess of Tuscany. When the fall of Napoleon enabled Ferdinand III. to return to his grand-duchy Sestini lost the appointment that he had held under the Princess Eliza, but this prince was afterwards induced by the merits of the numismatist to re-establish him in his former office, and to add to it the title of honorary professor of the University of Pisa. Among the numerous treatises that he published in addition to that above mentioned the principal are *Lettere e Dissertazioni numismatiche* (including the four volumes just referred to), which appeared at Leghorn, Rome, Berlin, Milan, Pisa, and Florence, from 1789 to 1820, in eighteen vols. 4to, with many engravings; the *Descriptio Nummorum veterum ex variis Museis* (Leipzig, 1796, 4to); and *Classes generales seu Moneta vetus Urbium, Populorum et Regum Ordine Geographicum et Chronologico descr.* (Florence, 1821, 4to, second edition), which may serve, in many respects, as a general index to all these works. His library and manuscripts were purchased by Grand-duke Leopold II. of Tuscany. Among the MSS. the principal is a *Systema geographicum Numismatum*, making up fourteen folio volumes.

SESTOS. See ABYDOS.

SETHITES, a Gnostic sect that existed in Egypt in the second century and bore some resemblance to that of the Ophites. They worshipped Seth, the son of Adam, as the son of God, but not of the creator of Adam and Eve, and maintained that he had re-appeared in the person of Jesus Christ. They pretended to have several books written by him.

SET-OFF, in law, is when the defendant acknowledges the justice of the plaintiff's demand on the one hand, but on the other sets up a demand of his own to counterbalance that of the plaintiff, either in the whole or in part; as if the plaintiff sue for £100 due on a note of hand, the defendant may set off £90 to himself for merchandise sold to the plaintiff, or for any other demand, the amount of which is ascertained in damages.

SETON, a skein of silk or cotton, or something similar, passed under the true skin and the cellular tissue beneath, in order to maintain an artificial issue.

The name, which is derived from the Latin *seta*, a hair, because hair was originally used for the purpose, is also given to the issue itself. To insert a seton the surgeon takes a fold of the skin between his fingers, and makes an incision at the base either with a knife or with a seton needle. In the former case the seton must be inserted by means of a probe, but when a seton needle is used that instrument carries the seton along with it. This needle is an instrument about 5 inches in length, and at its thickest part, about two-thirds of its length from the point, about  $\frac{1}{4}$  inch broad, slightly curved on the flat sides, and having two cutting edges from the point to the thickest part. The seton that it carries along with it is usually smeared with some ointment. When the seton is inserted the wound is bandaged up not very tight, and allowed to remain untouched until suppuration has set in, usually the third or fourth day. After that the wound is dressed with fresh linen regularly once or twice a day, and when the seton has become hard and stiff a new one is inserted, by attaching one end of the new one to one end of the old, and then extracting the latter, so that the fresh one is dragged into its place. When sufficient irritation is not produced by a simple seton of this nature some irritant substance is applied to the seton so as to produce the desired effect. Setons are applied sometimes as counter-irritants, when they are applied to the neighbourhood of the part affected, sometimes to relieve the system generally, when they are always inserted at the nape of the neck, and sometimes to excite inflammation with the view of promoting adhesion. In inserting a seton great care must be taken not to cut below the subcutaneous cellular tissue, as the injury of the muscular fibres in such operations has been known to give rise to fatal cases of tetanus.

**SETTER** (*Canis familiaris*), a breed or variety of Dogs, so named from their habit of crouching or 'setting' on observing the game which they are trained to hunt. Formerly the setters were said to crouch or drop on scenting game, but in modern days, and probably through association with the pointer (which see), these dogs simply remain erect on coming up with the quarry. Of the various kinds of setters the English Setter, Russian and Irish Setters are the three distinct breeds. The marks of a typical English or Irish Setter are a head of moderate size; the muzzle not so broad as in the pointer, with its lower angle rounded off; the eye sparkling and quick; the ears long, thin, and covered with wavy, silken hair; the tail provided with a fan-like 'brush' of long hair, and slightly curled at its tip; and the hind legs and feet are hairy and fringed. The Russian Setter has a thick woolly fur, and possesses a very keen scent. This latter breed, crossed with the English Setter, produces an admirably sharp variety. The muzzle of the Russian Setter is bearded, and the soles of the feet are hairy. Setters are fond of the water, and some of these dogs are said to be dissatisfied unless they are allowed to wet their coats before beginning to seek the game. The scent of the game is derived apparently from the air alone, and hence these dogs are in some degree different from the foxhounds, &c., which track the prey by the smell of the ground.

**SETTLEMENT, ACT OF**, a name given to a statute, 12 and 18 William III. cap. ii., by which the crown was limited to the present reigning house in Britain, the descendants of the Princess Sophia, youngest daughter of the Princess-palatine Elizabeth, daughter of James I., and by which some new provisions were added in favour of the subject, securing his liberty and the rights of conscience.

**SETTLEMENT OF PAUPERS.** The *prim*

*facie* settlement of a pauper is the place of his birth, and this remains his settlement until he has acquired another settlement, which may happen in England in any of the following ways. First, if not emancipated from parental authority a legitimate child may acquire a new settlement by a change of settlement on the part of his father, or after his father's death on the part of his mother. An illegitimate child, however, follows the settlement of his mother up to sixteen years of age, or until he acquires another for himself. Secondly, a woman on marrying takes the settlement of her husband, and retains it after his death; but if her husband, having been born abroad, has no settlement by birth, and has acquired none in any other way, she retains the settlement that she had before her marriage. Thirdly, a settlement may be acquired by renting for at least one whole year a tenement of the value of at least £10, and paying poor-rate in respect of it, and residing in the parish in which the tenement is situated for at least forty days. Fourthly, a settlement may be acquired by being bound an apprentice and residing during such apprenticeship for at least forty days in the parish in which the service takes place or some other parish. No settlement is gained, however, by being apprenticed to the sea service, or to a householder whose trade is of the seas, as that of a fisherman. Fifthly, a temporary settlement is acquired in a parish by the possession of an estate, but this settlement only continues as long as the owner of the estate resides within 10 miles thereof. Sixthly, a settlement may be gained by being assessed to and paying the taxes of a parish, other than those for scavengers and highways and the duties on houses. But the conditions attached to this mode of acquiring a settlement make it almost entirely equivalent to the third mode mentioned above. Finally, a settlement may be acquired by residence for one year in another parish than that in which one was born. The chief difference between the Scotch and English law of settlement is that the former requires a person to have resided five years in another parish than that in which he was born before he can acquire a settlement in such other parish. It is sufficient residence if a particular parish has been for five years the most common resort of a pauper, even though he may have resided for a large part of each year elsewhere. See **POOR LAWS** and **REMOVAL OF THE POOR**.

**SETUBAL**, or **SETUVAL**, or as it is called by the English **ST. UBS**, a town of Portugal, in **Estremadura**, 20 miles south-east of Lisbon. It is situated in a bay of the Atlantic, at the mouth of the river Sado, with a capacious and deep harbour, the approach to which is, however, much encumbered by sand-banks. It exports lemons, olives, oil, wine, and above all bay-salt, of which great quantities are made here. There are also tanneries and sardine fisheries. The town is fortified and possesses an arsenal. Pop. (1900), 21,819.

**SEVASTOPOL**, or **SEBASTOPOL**, previous to the Crimean war the great naval station of Russia in the Black Sea, is situated on a peninsula near the south-western extremity of the Crimea. A creek of the Black Sea, entering from the west, stretches east for nearly 4 miles in a deep hollow between lofty limestone ridges, which completely shelter it on the north and south. This creek, which widens out from 1800 yards at its entrance to about 1 mile, and then diminishes to 600 yards, has an average depth of about 10 fathoms, and forms an admirable roadstead, where the largest vessels lay secure from storms, and were guarded from hostile attack by sea by batteries of a very formidable description. From this roadstead thus lying east and west several minor creeks lead off to the south. One of these, 400 yards

wide at its entrance and  $1\frac{1}{2}$  mile long, formed the harbour proper. Sevastopol had grown up since 1780, when it was a mere Tartar village named Akhtiar. On the outbreak of the Crimean war it became the point against which the operations of the allies were mainly directed, and its siege forms one of the most remarkable episodes in modern history. On the sea-side the fortress was found to be absolutely impregnable, and the attack was therefore made chiefly on the land-side. There the original defences were not so formidable, but new and strong earthworks and batteries, the principal being the Malakoff and the Redan, were rapidly and continually erected during the operations. The investment of Sevastopol took place in September, 1854, and on the 17th of October the bombardment was commenced both by land and by sea. The siege lasted till Sept. 8, 1855, when the Russians had to evacuate the city, in consequence of the Malakoff having been stormed by the French. (See CRIMEAN WAR.) By the Treaty of Paris in 1856 it was stipulated that no arsenal should exist on the shores of the Black Sea, but these obligations have been repudiated by Russia, and the new fortifications of Sevastopol are likely to exceed those that were demolished. The town, also, has been reconstructed on a new plan; and since railway communication has been opened up with Moscow and the interior, it has risen into importance as a seat of commerce. Large wharves and warehouses and a custom-house have been built. The Malakoff, Redan, and Flagstaff batteries have been laid out as boulevards, dedicated to England, Russia, and France. Population, which is largely military, in 1897, 54,442.

**SEVEN.** To this number a kind of sacred character is attached in the Bible, and the same character was also given to it by most of the great nations of antiquity (Persians, Indians, Egyptians, Greeks, and Romans). In the Bible the number first appears in the opening of Genesis, where it is said that God performed the work of creation in six days, and rested the seventh day. As in the creation, so in many other things that proceeded from the hand of God, this number is prominent. Thus Egypt enjoyed seven years of plenty and was visited with seven years of famine (Gen. xli.); for seven days the rivers and waters in Egypt were turned into blood (Exod. vii.); God threatens to punish the Israelites seven times in case of their disobeying his commands (Lev. xxvi. 18); David is allowed to choose between seven years of famine and two other alternatives as punishment for his sin in numbering the people; and so in other instances. The number seven and multiples of seven also prevail in various sacred observances, and especially in the offerings that were prescribed to the Jews. Thus the Sabbath was the seventh day of the week, the seventh month of the year was the Sabbatical month, the seventh year was the Sabbatical year or year of rest to the land, and the year following the completion of seven weeks of years or seven periods of seven years was the year of jubilee. The feast of tabernacles, which took place in the seventh month of the year, lasted for seven days, and while it lasted there were offered up seventy (ten times seven) young bullocks, fourteen (twice seven) rams, and ninety-eight (twice seven times seven) lambs (Num. xxix.). Seven days of purification were required for a woman after the birth of a male child, and twice seven days after the birth of a female child. The golden candlestick had seven lamps (Exod. xxv.); and in the New Testament we have the seven deacons (Acts vi. 5); and the same number occurs repeatedly in the Revelation, where mention is made of the seven churches in Asia, symbolized by the seven candlesticks, the

seven seals, seven trumpets, seven vials, seven eyes, seven spirits, &c. The number seven has been preserved as a sacred number in the Roman Catholic Church, which has seven sacraments, seven penitential psalms, seven deadly sins, &c., and it played a very prominent part in the superstitions of the middle ages. Among the Greeks the mystic character of this number was recognized especially by the inhabitants of Euboea; and it also held a conspicuous place in the doctrines of the Pythagoreans. Among the ancient Egyptians, as well as among the Jews, the week was divided into seven days, and this division was adopted by the Romans before the Christian era. Various reasons have been given for the peculiar reverence attached to this number, such as that seven is a symbol of completeness and perfection as being compounded of three and four, two numbers perfect in their own nature through their capability of being represented in space by the triangle and the square; but the most probable explanation of the fact, at least among heathen nations, is the astronomical one, which ascribes it to the observation that there were seven planets.

**SEVENOAKS**, a market-town of England, in Kent, situated on rising ground amid beautiful scenery, 20 miles S.E. of London by railway. It has a parish church (restored), two other churches, a grammar-school, an institution for the daughters of missionaries, &c. Pop. in 1901, 8106.

**SEVEN SLEEPERS.** In the time of the Emperor Decius, when the Christians were persecuted, it is said that seven noble youths of Ephesus concealed themselves in a neighbouring cavern, the entrance of which was closed by order of the emperor. The persecuted youths immediately fell into a deep slumber, from which they were accidentally awakened in the reign of Theodosius II., after the lapse of about two centuries. Pressed with hunger after their long fast, they sent one of their number to the city to purchase bread. He was astonished to see crosses erected all over the city; and his own antiquated dress and obsolete language confounded the baker, to whom he offered an old medal in payment for bread. Suspected of having found a secret treasure, he was carried before the judge, to whom he related his miraculous story. The Bishop of Ephesus, the magistrates, and the emperor himself, hastened to the cave, and found the sleepers still bearing the bloom of youth. They related their story to the multitude, gave them their benediction, and expired. The church has consecrated the 27th of June to their memory. This legend has not been confined to the Christian world. The Koran relates the tale of the seven sleepers, out of respect for whom it declares that the sun altered his course twice a day that he might shine into the cavern. The Mohammedan and Christian story are probably both derived from the same source. The origin of the Christian story is said to have been that seven Christian youths actually had taken refuge from persecution in a cave in the manner stated in the legend, that their dead bodies were found there many years after, and that the Christian historians in recounting the fact in speaking of their death employed the usual phrase and said they had fallen asleep in the Lord.

**SEVEN SORROWS OF THE VIRGIN**, FEAST or, a Roman Catholic festival, instituted in 1725 by Pope Benedict XIII., and celebrated on the Friday before Palm Sunday. The seven sorrows commemorated by this feast are (1) the prediction of Simeon (Luke ii. 34, 35); (2) the flight into Egypt; (3) the loss of Jesus in Jerusalem; (4) the sight of Jesus bearing his cross; (5) the sight of Jesus on the cross; (6) the piercing of the side of Jesus; (7) the burial of Jesus.

**SEVEN STARS.** See **PLEIADÆ.**

**SEVENTH-DAY BAPTISTS.** See **BAPTISTS** and **SABBATARIANS.**

**SEVENTY, THE.** See **SEPTUAGINT.**

**SEVEN WISE MASTERS**, the title of a collection of tales which originated in the East at a comparatively early period. The plot connecting the tales is the following:—A king's son, who had been instructed in all branches of knowledge by seven wise masters, finds by the study of the stars that he is in danger of meeting his death if he utters a word within seven days. At the commencement of this period his stepmother, whose improper advances he had repulsed, accuses him to her husband of an attempt to offer her violence, and urges him to put his son to death, at the same time telling him a story calculated to induce him to do so. The king is just about to act on this advice when one of the seven wise masters obtains a day's respite for the prince by telling a tale the moral of which counteracts that of the stepmother's. On each of the following six days during which the prince's danger binds him to silence, the stepmother renews her solicitations to the king to have the prince put to death, on each occasion supporting her advice by a fresh story, but the effect of the stepmother's tales is always counteracted by another told by one of the seven wise masters, until the expiration of the seven days enables the prince to reveal the designs of his stepmother. The date and circumstances of the origin of this collection of tales are unknown. According to the statement of Maundil (died 956 A.D.), which agrees with that of Mohammed Ibn-el-Bedin el-Werrak, there were already two Arabic versions in the tenth century, and Mohammed ascribes to the work an Indian origin. The plot of the work is in fact found in Buddhist literature, not as a fable but as a real event, but no Indian original of the collection of tales has been discovered. The tales were without doubt introduced into the West through the Crusades, since which the collection has been translated into almost all western languages. A Latin version by Joannes de Alta Silva existed before the close of the twelfth century, and was the original of the French poem of Dolopathos, which dates from the early part of the thirteenth century, and an edition of which appeared at Paris in 1856. A second Latin version, of which only an extract has been preserved in the original, was probably the basis of the English versions that appeared under the care of Weber, Ellis, and Wright. The German, Dutch, Swedish, and Spanish versions are traced to a third Latin original, while the Italian versions form a group by themselves.

**SEVEN WISE MEN, or SEVEN SAGES OF GREECE.** This name is commonly applied to seven philosophers, several of whom were legislators of an early period of Grecian history. Their names are variously given, but as commonly set down they were Pericles of Corinth (in place of whom some give Epimenides of Crete), Pittacus of Mitylene, Thales, Solon, Bias of Priēnē, Chilo of Sparta, and Cleobulus of Lindus. They were traditionally believed to be the authors of short sentences, chiefly maxims of prudence and elementary morality, which were commonly regarded as embodying a summary of their wisdom. Among these maxims are, 'Know thyself,' 'Nothing in excess,' 'Consider the end,' &c. Different accounts do not agree as to their authorship. See Bohren *De Septem sapientibus* (Bonn, 1867).

**SEVEN WONDERS OF THE WORLD**, seven monuments, remarkable for their splendour or magnitude. They are the pyramids of Egypt, the walls and hanging gardens of Babylon, the temple of Diana at Ephesus, the statue of the Olympian Jupiter at Athens (see **PHIDIAS**), the Mausoleum (see **ARTEM-**

**ISIA** and **MAUSOLEUM**), the Colossus of Rhodes (see **COLOSSUS**), and the Pharos or light-house of Alexandria. This group of the seven wonders originated among the Greeks in the time of Alexander. Philo the Byzantine has described them in his work *De septem Orbis Spectaculis* (best edition, Leipzig, 1816).

**SEVEN YEARS' WAR.** By the treaties of peace concluded at Breslau, July 28, 1742, and at Dresden, December 25, 1745, Maria Theresa of Austria ceded to King Frederick II. six principalities of Silesia and the county of Glatz. The loss of these fine territories was too painful for her not to think of recovering them. For this purpose she concluded an alliance with Elizabeth, the empress of Russia, whom Frederick had offended by his sarcasms, brought over to her cause the King of Poland and Elector of Saxony, Augustus III., and attempted to form a closer union with France, notwithstanding the enmity that had existed between that kingdom and her own for centuries. While Maria Theresa was occupied in these projects a dispute had arisen between Britain and France relating to the boundary between their possessions in America, which broke out in 1755 into open hostilities. To protect his German states against an attack from France the King of England concluded an alliance with Prussia; and some months after France made a league with the court of Vienna, promising to furnish 24,000 auxiliary troops against Prussia. But these auxiliaries were afterwards increased to 180,000; for it was rather the design of France to injure the King of England by conquering Hanover, than to aid in accomplishing the ambitious designs of the empress on Silesia. By means of Menzel, a clerk in the Saxon cabinet, whom Frederick kept in his pay, all the proceedings of the Russian, Austrian, and Saxon courts were discovered to Frederick, who, as usual, resolved to anticipate his enemies. In August, 1756, therefore, he invaded Saxony, the capital, which had been deserted by the court, occupied Leipzig, Wittenberg, and Dresden; took possession of the documents necessary to justify his conduct, which he found in the archives of the cabinet in the last city, and invested the Saxon army in their fortified camp at Pirna. Meanwhile Field-marshal Browne advanced from Bohemia with an army to liberate Saxony; but Frederick was able to check his advance, and the Saxons, 14,000 strong, were forced to surrender (Oct. 15). The inferior officers and common soldiers were compelled to enter the Prussian service; but they soon deserted, both singly and in whole regiments, making their escape to Poland, where the Saxon court resided during the whole war. Such was the end of the first campaign, and the Prussians remained through the winter in Saxony and Silesia. Frederick's invasion of Saxony excited a general commotion in the courts of Europe. It was pronounced to be a violation of the Treaty of Westphalia, and France, as one of the guarantors of that treaty, now took part in the struggle. Sweden, too, on the same pretext, and with the hope of recovering her Pomeranian possessions; and Russia, on account of her alliance with the empress, adopted a similar course. In the diet at Ratisbon, held in January, 1757, war was also declared on the part of the empire against Prussia.

Thus in 1757 Austria, Russia, France, Sweden, and the German Empire were in arms against Frederick, while he had no ally but England and a few German states (Brunswick, Hesse-Cassel, Gotha, besides of course Hanover). In order to be again beforehand with his enemies Frederick, in April, 1757, marched into Bohemia, and on the 6th of May a bloody battle was fought at Prague, in which the Prussians conquered, but lost their distinguished general Schwerin. The greatest part of the van-

quished Austrian army threw itself into the city of Prague, to which the king immediately laid siege. But the defeat of Frederick by the Austrians under Daun, at Kollin, in the following month (June 18), deprived the former of all his advantages. He was forced to raise the siege of Prague, and to retreat to Saxony and Lusatia. Little more than a month after (July 26) the Duke of Cumberland, commanding the German allies of Frederick, was defeated at Hastenbeck on the Weser, in the south of Hanover, by the greatly more numerous army of the French; whereupon the victors made preparations for taking up winter quarters along with the imperial army in Saxony. The two armies had already united and advanced as far as the Saale, the French under the command of the incapable Prince Soubise, a favourite of the Marquise de Pompadour, when Frederick marched against them, and fought at Rossbach, a village between Merseburg and Weissenfels, that memorable battle, in which both the French and the imperial armies were defeated, and found safety only in a hasty flight (Nov. 5). The defeated armies retired into winter quarters at a distance, and the possession of Saxony was secured to the king. Upon this Frederick hurried back to Silesia, which was now occupied by the Austrians. With a small army, fatigued with a long march, he defeated at Leuthen a force twice as great, under Daun (Dec. 5). By this victory Frederick recovered Silesia, and he was now more formidable to his foes than ever; for not only had he been victorious himself, but while he had been thus occupied in the south and west his general Lehwald had successfully repelled the Swedes and Russians on the north and east.

The third campaign was opened in February, 1758, by Ferdinand, duke of Brunswick, who was now at the head of the allied armies, in the room of the Duke of Cumberland, and opposed the French in Lower Saxony and Westphalia. His nephew, the hereditary prince, afterwards Duke of Brunswick, Charles William Ferdinand, commanded under him. Duke Ferdinand made himself master of the Weser, expelled the French, under Clermont, from Lower Saxony and Westphalia, and defeated them, June 23, at Krefeld. He then returned over the Rhine to Hesse, where Soubise was stationed with a French army, and whither Clermont followed him. Ferdinand, in the meanwhile strengthened by 12,000 British troops, forced the two hostile bodies to retire over the Main and the Rhine, where they went into winter quarters. Meanwhile the Russians, under Bestucheff, had advanced as far as the Oder; and subsequently Fermor, who superseded Bestucheff, occupied East Prussia, and then moved into Brandenburg, spreading devastation on his way. At this juncture Frederick made a masterly march to the Oder, and towards the end of August engaged the Russians at Zorndorf, in the north of Brandenburg, where he gained a sanguinary victory, which forced the Russians to retreat to Poland. After this he again turned his attention to Saxony, where his brother Prince Henry was no longer able to resist the Austrians. He encamped at Hochkirch, but here he was surprised by Daun in the night of Oct. 14, and suffered a total defeat. He nevertheless succeeded with the remains of his army in effecting a junction with his brother, after which he again drove the enemy out of Silesia and Saxony. At the close of the campaign the king saw all his dominions except Prussia proper free from the enemy. In France there was a general wish for peace; but Louis XV. and his mistress, the Marchioness de Pompadour, were bent on continuing the war. A new alliance was therefore concluded with Austria, December 30, 1758. Frederick, however, had also

obtained a new treaty with Britain, which promised him a large yearly subsidy. Yet he determined in the coming campaign to act with his main army as much as possible on the defensive, and to commit aggressive movements to detached corps.

The campaign was opened in March, 1759, Prince Henry marching into Bohemia, where he dispersed the hostile forces, and captured immense quantities of military stores. He then entered Franconia, and put the inactive imperial forces to flight. At the same time the Prussian general Dohna drove back the Swedes once more to Stralsund, and managed to keep the Russians for a time in check. But when the Russians pressed forward in ever-increasing numbers under Soltikoff, Dohna found himself obliged to give way. Frederick then gave his command to General Wedel, who received orders to prevent the junction between the Russians and Austrians at all costs, and accordingly on the 23d of July attacked the Russians at Kay, near Züllichau, in the east of Brandenburg. His attack was unsuccessful, and the Russians after their victory advanced to Frankfort-on-the-Oder. Frederick now hastened in person to his electoral dominions, and on the 12th of August attacked the Russians at Kunersdorf, near Frankfort, and had already defeated them when the victory was snatched from him by the Austrians under Laudon, who inflicted on him a defeat such as he had never sustained before. The Russians purchased their victory dearly, and they made no use of it. Yet Frederick's position was extremely dangerous; indeed, he began to apprehend an unfortunate issue of the war. The Russians were victorious in his hereditary states; Daun was in Lusatia with a large army, and Saxony was overrun by the imperial troops. The Austrians and Russians wished to unite, but Prince Henry deprived the former of their magazines, and thus obliged them to retreat; and Frederick anticipated the Russians in their march to Silesia, and compelled them to retire to Poland. In the west Frederick's allies had been more successful. They had, indeed, been able to effect little at the beginning of the campaign. The French had taken Frankfort-on-the-Main by surprise during the winter, and the plan for recovering the city was frustrated by the failure of the attack on Bergen (April 13). But (Aug. 1) Ferdinand gained a splendid victory at Minden over the French troops under Contades and Broglie. On the same day the hereditary Prince of Brunswick likewise defeated the French at Gohfeld, and they were driven over the Lahn on one side and over the Rhine on the other. The Swedes also, who, after the battle of Kunersdorf, when Prussian Pomerania was destitute of troops, invaded that country, were driven by Manteuffel and Platen under the cannon of Stralsund. Thus, in spite of all his mishaps, Frederick's fortunes were still at the end of the campaign in the ascendant.

The campaign of 1760 seemed at first to forebode ill success to Frederick. While he himself was engaged in Saxony the brave General Fouqué suffered a defeat in Silesia, in consequence of which the Austrians occupied the whole land. Frederick thereupon gave up Saxony in order to recover Silesia. With 30,000 Prussians he marched into that province, and entrenched himself at Liegnitz. Here on the 15th of August he defeated Laudon, by which he effected his purpose of recovering Silesia, but he was unable to prevent Austrian and Russian troops from breaking into Brandenburg and laying waste his hereditary dominions. Frederick hastened thither to cut off the enemy, but not finding them there he returned to Saxony, where the imperial forces were stationed, and Daun and Lescy had united. At Torgau, on the Elbe, he attacked the enemy (Nov. 8), defeated

them in a bloody engagement, and then went into winter quarters in Saxony. The Russians also were forced to raise the siege of Colberg and to retire to Poland. The allied forces, under Ferdinand of Brunswick, defeated the French (July 31) at Marburg; but the latter remained in Hesse.

In the opening of the next campaign (February 11, 1761) Ferdinand attacked the French in their quarters; they fled, losing many of their fortifications and magazines. A corps of French and Saxon troops was defeated, February 14, at Langensalza; but the allies were obliged to raise the siege of Ziegenhain, Marburg, and Cassel with loss, and the French once more became masters of all Hesse, and had an unobstructed passage to Hanover. The proposals of peace now made by Britain and Prussia were not accepted, and Frederick endeavoured to protect Silesia against the Austrians and Russians, who had united, in August, at Striegau. He and his allies, however, met with reverses at Schweidnitz, Colberg, and elsewhere, and despite some successes (as at Villinghausen) Frederick felt himself in a desperate condition. But at the very time when Frederick's distress was greatest, Elizabeth, the empress of Russia, died (January 5, 1762), and her successor, Peter III., concluded with him (May 5) the Peace of St. Petersburg. Sweden likewise made peace with Prussia, and the Russian emperor sent a body of troops to aid the Prussians. But the emperor's early death broke the alliance with Frederick, and his successor, Catharine II., recalled the Russian troops from the Prussian service. Frederick, however, was delivered from one dangerous enemy, and had gained an important preponderance of strength over the rest. After recovering Schweidnitz and providing for the defence of Silesia he marched to Saxony. On October 29 an important victory was gained over the Austrian and imperial troops at Freiberg, and the king now concluded an armistice with the Austrians; but it related only to Saxony and Silesia. Under Duke Ferdinand and the hereditary Prince of Brunswick the allies commenced, unsuccessfully, the campaign of 1762 against the French; but the latter were defeated (June 24) at Wilhelmsthal, and driven from their fortified camp at Cassel. Cassel itself was besieged, and (November 1) surrendered to the allies. Two days after this the preliminaries of peace between Britain and France were signed, and the peace itself was confirmed at Paris, Feb. 10, 1763. After a short negotiation Frederick concluded a peace with Austria and Saxony at Hubertsburg (February 15), by which each power received again all the territories it had possessed before the war. The simultaneous struggle between Britain and France in North America and India ended in the complete triumph of the former. See *History of the Seven Years' War*, by Lloyd; and Carlyle's *Frederick the Great*.

**SEVERIANS, SEVERITES.** See **GNOSTICS** and **MONOPHYTES**.

**SEVERN**, after the Thames the largest and most important river in England, formed by the union of two small streams which rise on Plinlimmon, near the source of the Wye, and unite at Llanidloes, in south Montgomeryshire. It flows north-east through the eastern part of that county, past Newtown and Welshpool, to the western borders of Shropshire, and then east to Shrewsbury, which it nearly encircles. From Shrewsbury, a little below which it receives the Tern on the left, it flows circuitously south-east through the rest of Shropshire, crosses the extreme south-west part of Stafford, and then flows south through Worcestershire, passing the town of Worcester, and receiving the Teme on the right a little below it. At Tewkesbury, on the borders of

Gloucestershire, where the Upper Avon joins it on the left, it begins to flow south-west; passes the town of Gloucester, a little above which it branches, forming the Isle of Alney; makes several remarkable windings, begins to become a great tidal river, and after forming a broad estuary, in which it receives the Wye a little below Chepstow, on the right, and the Lower Avon about 8 miles below Bristol, on the left, falls into the Bristol Channel. Its whole length is about 210 miles, and its basin has an area of 5960 square miles, of which 1610 represent the basin of the Wye. It begins to be navigable at Welshpool, about 178 miles above its mouth and 225 feet above sea-level. Recent improvements make it possible for vessels of 400 tons to ascend as far as Worcester. Below Gloucester its navigation is much impeded, but this has been obviated by a canal from Gloucester to Sharpness docks on the estuary 2 miles from Berkeley. Below Gloucester the banks become so low that destructive inundations have not unfrequently occurred. One of the most remarkable features of the river is its *bore*, or tidal wave. A railway tunnel  $4\frac{1}{2}$  miles long, passing under the estuary 2 or 3 miles below the mouth of the Wye, was completed in 1886, and a railway bridge crosses it higher up.

**SEVERO, SAN**, a town in Italy, in the province of Foggia. It is tolerably well built; and contains a cathedral, a seminary for the clergy, and a hospital. Pop. 21,000.

**SEVERUS, ALEXANDER.** See **ALEXANDER SEVERUS**.

**SEVERUS, LUCIUS SEPTIMIUS**, a Roman emperor, was born near Leptis, in Africa, of a family of equestrian rank, in 146 A.D. He successively exercised various public offices, and under Commodus he received the command of the legions serving in Pannonia and Illyria. After the murder of Pertinax, in March, 193, he was proclaimed emperor by his troops at Carnuntum. He resolved to accept the honour, and accordingly marched to Rome to crush the partisans of Didius Julianus, who had meanwhile purchased the imperial purple from the prætorians. On his approach Julian was deserted by his favourites, and assassinated by his own soldiers. In professing that he had assumed the purple only to revenge the death of the virtuous Pertinax, Severus gained many adherents, and was enabled to banish the prætorians. But while he was victorious at Rome, Pescennius Niger was in the East at the head of a powerful army, by which he also had been called to the purple. Getting rid of the dreaded rivalry of Albinus by conferring upon him the title of Caesar, Severus at once directed his arms against this eastern competitor. Many obstinate battles were fought between them, till, on the plains of Issus, Niger was totally ruined by the loss of 20,000 men (A.D. 194). Niger was captured in flight and put to death, and his partisans were ruthlessly punished. After devastating some territory beyond the Euphrates, Severus took Byzantium, which had shut her gates against him, but only after a protracted siege (A.D. 196); and he then returned to Rome, resolved to destroy Albinus. He attempted to assassinate him by his emissaries; but when this failed, Severus had recourse to arms, and the fate of the empire was decided near Lyons (197). Albinus was defeated, and the conqueror insulted the dead body of his rival, who had died by his own hand. The adherents of Albinus shared his fate; and the return of Severus to the capital recalled the bloody triumphs of Marius and Sulla. After a short stay in Rome Severus marched into the East with his sons Caracalla and Geta, to repel an invasion of the Parthians; made himself master of Seleucia, Babylon,

and Otesiphon; and advanced far into the Parthian territories. From Parthia he marched towards the more southern provinces of Asia, and, after he had visited the tomb of Pompey the Great, entered Alexandria. He celebrated the completion of the tenth year of his reign and the marriage of his eldest son at Rome in a most magnificent, extravagant, and brutal manner, and for some years remained quietly at home, but the serious nature of a rebellion in northern Britain called him away again in 208. After penetrating to the far north of Caledonia, and losing a vast number of men, he returned southwards, and rebuilt or repaired the wall of Hadrian across the island from the Tyne to the Solway Firth. When about to suppress a fresh insurrection that had broken out he died at York A.D. 211.

SÉVIGNÉ, MARIE DE RABUTIN-CHANTAL, MARQUISE DE, a Frenchwoman of rank, greatly distinguished for her epistolary talents, was born at Paris on the 5th of February, 1626; and died at the château of Grignan in the department of Drôme, April 17, 1696. Her father, the Baron de Chantal, was killed on the island of Ré in 1627, when fighting against Buckingham's expedition, and her mother died in 1633. She was brought up by her maternal grandparents, and afterwards by her maternal uncle, the abbé de Livry. In 1644 she married the Marquis Henri de Sévigné, who was killed in a duel in 1651, leaving her the mother of a son and a daughter. She formed no second union, but devoted herself to the education of her children, and to the cultivation of her mind by reading and literary society. She was extremely attached to her daughter, who in 1669 married the Comte de Grignan, a widower. By this marriage Madame de Sévigné expected to be able to have her daughter always near her, but not long after it took place the Comte de Grignan was appointed lieutenant-general of Provence, and had to go with his wife to the district which he was to govern. After this mother and daughter were frequently reunited for longer or shorter periods, but for about seven years in all they lived apart, and this separation gave rise to the greater part of the letters which have gained Madame de Sévigné so much reputation. After the year 1687 Madame de Sévigné was rarely severed from her daughter, and in May, 1694, went to live with her permanently. She died of small-pox. The subjects of many of the letters of Madame de Sévigné are so entirely domestic as to be of little interest; but others abound with court anecdotes, remarks on men and books, and the topics of the day, which are conveyed with great ease and felicity. They are models of the epistolary style, perfectly natural from their expression, lively sentiment and description, and a playfulness which gives grace and interest to trifles. She was highly attached to rank and splendour, loved admiration and the pleasures and gaieties of Parisian society. Yet she enjoyed an occasional period of retirement to her estate of Rochers in Brittany, where she could pursue with more assiduity the chief pleasure of her life—her correspondence with her daughter—read her favourite authors, Virgil, Montaigne, Molière, Pascal, Arnauld and Nicole, and Corneille; and admire the beauties of nature, her sense of which is one of the most characteristic traits that appear in her Letters. She had a strong feeling of religion, but in reference to the proceedings against the Franch Protestants expresses herself with bigotry and want of feeling. The first edition of her Letters (which, it should be remembered, were never intended by her for publication) appeared at the Hague in 1728; a new one by the Chevalier de Perrin appeared in 1734. M. de Monmerqué repro-

duced the original text in his first edition (1818-20). The best edition is that in the *Grands Écrivains* series by Monmerqué (fourteen vols., 1862-66), completed by the *Lettres Inédites* of Capmas (two vols., 1872).

SEVILLE (Spanish, *Sevilla*), the fourth town of Spain in population, capital of Andalusia and of the province of Seville, and the seat of an archbishop, situated in a wide plain on the east or left bank of the muddy Guadalquivir, 65 miles north by east of Cadiz, with which and with Cordoba it is directly connected by rail. It communicates with the suburb of Triana on the right bank by an iron bridge built in 1845-52, and also by a newer bridge and a railway bridge. Despite its numerous very narrow streets it is a most picturesque and attractive town, with many open spaces planted with palms, orange-trees, acacias, and other like trees. Its two-storied houses, with their comparatively open courts or patios, are very interesting. Its climate is delightful, except in the height of summer, when the temperature is very high; but the town has suffered much from inundations of the river. Beside or near the Plaza del Triunfo are some of the chief buildings of the town, namely, the cathedral, the Casa Lonja or exchange, the Giralda, the Alcázar, and the archbishop's palace. The cathedral, one of the largest and finest in the world, was erected in 1402-1506 on the site of a mosque which had been used for some time as a church. The dome collapsed in 1888 and has now been reconstructed. The interior consists of a nave, double aisles, and transept, and the chapels contain many fine works in painting and sculpture. Immediately to the north of the cathedral is the Patio de los Naranjos (Court of the Oranges), with the Library of Columbus, founded by a son of the discoverer and containing some valuable works and manuscripts, on the east. The Giralda, built in 1184-96 as the minaret of the former mosque, is a beautiful specimen of Moorish work, which was restored in 1885-88. The exchange is a Renaissance edifice built in 1583-98, and contains a large collection of documents relating to the discovery, conquest, and rule of America in the Spanish period. The Alcázar, formerly a Moorish palace and now a residence of the Spanish king, was originally built in 1181, but dates in its present form from the time of Pedro the Cruel in the fourteenth century. Its exterior is like that of a mediæval castle and its interior is of great interest and beauty. There are extensive gardens behind it. The Ayuntamiento or city-hall is a splendid Renaissance building between the Plaza de la Constitución and the Plaza de San Fernando. It was erected in 1526-64 and restored in 1891. Beside it is the Audiencia or court of justice. Among the chief squares or places of resort not already mentioned are the Paseo de las Delicias, a fine promenade along the river bank; the Alameda de Hercules, with two Roman granite columns; the Plaza Atarazanas, beside which is the Hospital de la Caridad, an infirmary under the charge of Sisters of Charity, originally built in 1598 and containing fine pictures by Murillo and others, and also the Torre del Oro (Tower of Gold), originally a tower of the Moorish Alcázar; the Plaza del Museo, with a bronze statue of Murillo in the centre, and faced by the provincial museum, including an academy of fine arts, an archaeological museum, and a collection of paintings, many by Murillo; the Plaza del Duque de la Victoria, with a bronze statue (1892) of Velasquez; and the Calle de las Sierpes, a narrow, busy street where the best shops and clubs are located. The other edifices and institutions of the city include: several churches and convents; the university, founded in 1256, with the medical faculty at Cadiz;

the school of medicine, in a secularized convent; the market; the Casa de Pilatos, a sixteenth-century building in a mixed style, belonging to the Duke of Medinaceli; the Palacio de Santelmo, an eighteenth-century building; the founding hospital, founded in 1558; other hospitals; a penitentiary and a prison; artillery and cavalry barracks; a large tobacco factory erected in 1757, and a cannon foundry; theatres; a large bull-ring, &c. The suburb of Triana is inhabited mainly by gipsies and the lower classes. The elaborate church festivals and processions of the city are of much interest. Seville was formerly enclosed by a wall, of which there are some remains. There are two railway-stations and street tramways. The river at Seville is tidal, and has been much improved in recent years, so that ships of moderate size can now reach the city wharf. The number of vessels entered in 1901 was 1325, with a total tonnage of 833,693. The total value of exports in that year was £1,352,158, and of imports, £822,834. The chief articles of export are lead and lead-ore, quicksilver, iron-ore, olives and olive-oil, oranges, corks and corkwood, and copper pyrites; and the principal imports are timber, drugs and chemicals, coal, coke, and pitch, machinery, petroleum, and coffee. The manufactures include tobacco, porcelain, iron goods, soap, leather goods, chocolate, corks, &c. Seville was originally a Phœnician colony named *Sephela*, and was later known to the Romans as *Hispalis*. It was taken in B.C. 45 by Julius Cæsar, who renamed it *Julia Romula*. It afterwards became a capital of the Vandals and of the Visigoths, and in 712, after a month's siege, it was captured by the Arabs, who called it *Ishbiliya*. It was reconquered for Christendom by Ferdinand III. of Castile on Nov. 23, 1248, after a siege of six months' duration, and some 300,000 Moors were expelled. The discovery of America in the fifteenth century raised Seville to great commercial importance as the seat of American trade and the tribunal of the Indies. With the rise of Cadiz, however, Seville gradually lost most of its trade. It was occupied by Soult in the Peninsular campaign, and in 1843 it was bombarded and taken by Espartero. It is the birthplace of Velasquez, Murillo, Cardinal Wiseman, and Joseph Blanco White. Pop. in 1897, 146,205.—The province of Seville is bounded by Badajoz, Cordoba, Malaga, Cadiz, and Huelva, and has an area of 5428 square miles. It extends north to the Sierra Morena, and is watered by the Guadalquivir. Part of it in the lower valley of the river is marsh land (*Marismas*). Wheat, vines, olives, oranges, and other fruits and cereals, are cultivated, and horses and other animals are reared. Pop. in 1897, 547,020.

SEVRES, a town of France, in the department of Seine-et-Oise, on the left bank of the Seine, here crossed by an eighteenth-century bridge, about halfway between Paris and Versailles. Its most notable building and institution is the celebrated national porcelain manufactory, founded at Vincennes in 1745 and removed to Sèvres in 1756. It was acquired by Louis XV. in 1760. Since 1876 the factory has occupied a large building in the park of St. Cloud near the Seine, and the older building now accommodates a normal school for the secondary education of girls. In connection with the factory there is a school of ceramics and a ceramic museum, the latter the best in Europe. There are various other manufactures. The animal painter Troyon was born at Sèvres. Pop. in 1896, 7317.

SEVRES, Deux-, a department of France, formed chiefly out of the ancient Poitou, Saintonge, and Angoumois, bounded north by Maine-et-Loire, east by Vienne, south-east by Charente, south-west by Charente-Inférieure, and west by Vendée; area,

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2316 square miles. A central district of low granite and schistose hills, extending from the south-east to the north-west, is called the Gâtine, and divides the department into two portions of different drainage and physical character. The drainage of the north, centre, and east goes to the Loire by the Sèvre Nantaise, the Thouet, and some affluents of the Vienne; the south and south-west is drained by the coast river Sèvre Niortaise; and a part in the south-east belongs to the basin of the Charente. The climate of the north and centre is colder and moister than that of the south; some parts are rather unhealthy. The soil on the whole is fairly fertile and has been much improved; the chief crops are wheat, oats, barley, potatoes, and the vine. Coal, iron, antimony, and other minerals are found, and marble is extracted. The chief manufactures are cloth, gloves and other leather goods, pottery, &c. The department is divided into the four arrondissements of Bressuire, Parthenay, Niort, and Melle. Niort is the capital. Pop. in 1896, 344,693; in 1901, 339,340.

SEWAGE.—Sewage may be defined as water and filth, which for hygienic or other reasons it is desirable to get rid of. The water may be made up of rain-water, surface-water, ground-water, and the waste-water from houses, workshops, factories, and other buildings. The filth may include: (1) *inorganic matter*, such as sand from roads, chemicals of various kinds from manufactories, ashes, coal-dust, &c.; and (2) *organic matter*, such as the waste-products of animals (including man), vegetable refuse, trade-refuse of certain kinds, grease, &c. In ordinary sewage there are also always present numbers of bacteria, some of which are pathogenic (that is, capable of producing disease under suitable conditions), but most of which serve the useful purpose of converting the noxious organic matter into more or less innocuous elements and compounds.

Sewage is known as 'strong' or 'weak' according to its degree of foulness, in other words, according to the nature and quantity of the filth per unit of water. To the eye and nose the weaker sewage is the better, but to the engineer a weak sewage has many disadvantages, which will be obvious if we first consider to what the weakness is due. It is usually caused by the admission of rain-water and ground-water into the sewers. These vary very much in quantity according to the weather, the season of the year, and other factors, and the sewers must be made large enough to carry off the heaviest storm-water flow, and the sewage-disposal works must also be capable of dealing with this flow. Another disadvantage is, that every abnormal influx of water into a sewer expels the sewer-air, partly through the gratings and shafts provided for the purpose and partly also through the traps of house-drains connected with the sewer. On the other hand, such an influx of water may be of service in flushing the sewers. The disadvantages, however, are so serious that engineers are agreed that ground-water should be excluded from the sewers as much as possible, and many strongly advocate that a large part of the rain-water should also be excluded. This, of course, necessitates a double, or, as it is usually termed, a 'separate' system of sewers—one for sewage proper and the other for ground-water and rain-water.

The amount of the water-supply also affects the quality of the sewage. In many villages the water-supply per head of population is less than 5 gallons daily, while in the majority of towns it is over 25 gallons, and in some it is even more than 100. The normal dry-weather sewage of different places varies therefore very much in strength.

**Composition of Sewage.**—This varies not only according to the amount of dilution, but also according to the nature of the solids in it, the latter variation being chiefly due to the geological formation of the district, the materials of which the road-surfaces are formed, and to different trade-processes, the waste waters from which are allowed to enter the sewers. In some towns the manufacture of 'chemicals' is the staple industry, in others dyeing, in others brewing, in others paper-manufacture, while in others again many different industries are carried on resulting in a sewage of complex character which may vary widely throughout the day. Contrary to popular opinion, the prevalence or absence of water-closets makes very little difference in the nature of the sewage, except in places where the water-supply is abnormally small.

In many analyses of sewage the solids are stated in grains per gallon, a gallon weighing 70,000 grains, and in others in parts per 100,000. To convert grains per gallon into parts per 100,000 it is simply necessary to multiply the former by 10 and divide by 7, and to convert 'parts per 100,000' into 'grains per gallon' multiply the 'parts' by 7 and divide by 10. The 'total solids' are usually stated, and these may be subdivided into 'organic' and 'min-

eral', and into 'solids in suspension' and 'solids in solution'. Thus, the total solids of a typical English sewage may be, say, 120 parts per 100,000, made up as follows:—

1. Solids in suspension—		
(a) Organic.....	22	= 40
(b) Mineral.....	18	
2. Solids in solution—		
(a) Organic.....	20	= 80
(b) Mineral.....	60	
Total solids.....	120	

By far the greater part of the solid matter is in solution. The mineral portion of this will include dissolved salts of various kinds, including common salt, together with lime, iron, and other substances, which, while they render the water unfit for ordinary use, do not make it a nuisance. The mineral matter in suspension consists chiefly of fine particles of road-detritus. The organic matter is the dangerous part of sewage, and it is this part which needs to be carefully defined in an analysis. In the following table, the composition of the sewage of different towns is given on the broad lines just indicated:—

COMPOSITION OF SEWAGE, IN PARTS PER 100,000.

PLACE.	Total solids.	Solids in suspension.	Chlorine.	Ammonia.	
				Free.	Organic (albuminoid).
Average of 20 towns with middens.....	121.5	89.11	11.54	5.43	about .56
Average of 36 towns with water-closets.....	116.9	44.69	10.66	6.70	.63
London, Barking Outfall Works.....	123.7	38.28	11.42	4.87	.49
Burton-on-Trent (much trade-refuse from breweries).....	224	65.00	12.00	1.6	2.00
Sutton ('separate' system, 27 gallons per head per day).....	—	85.76	12.8	12.53	1.13
Ashstead (sewage from house of 10 or 12 persons).....	85.6	—	7.1	11.25	.30
Finchley.....	147	—	12.5	8.1	1.1
Derby.....	137	57	9.9	7.2	1.12
Alfreton (few water-closets).....	204	80.5	17.4	8.8	1.64
Village, Staffordshire (slop-water closets).....	158	—	19.6	19.7	2.53
Wolverhampton (much trade-refuse from galvanizing works).....	496	50	173.0	1.72	1.17
Wolverhampton (with trade-refuse treated before admission to sewers).....	154.8	43.44	21.91	6.70	2.47

The amount of the chlorine furnishes a good index of the strength of sewage, and as it is not removed by the ordinary processes of purification, it affords the best means of comparing the character of the crude sewage and of the purified effluent which is said to have been obtained from it.

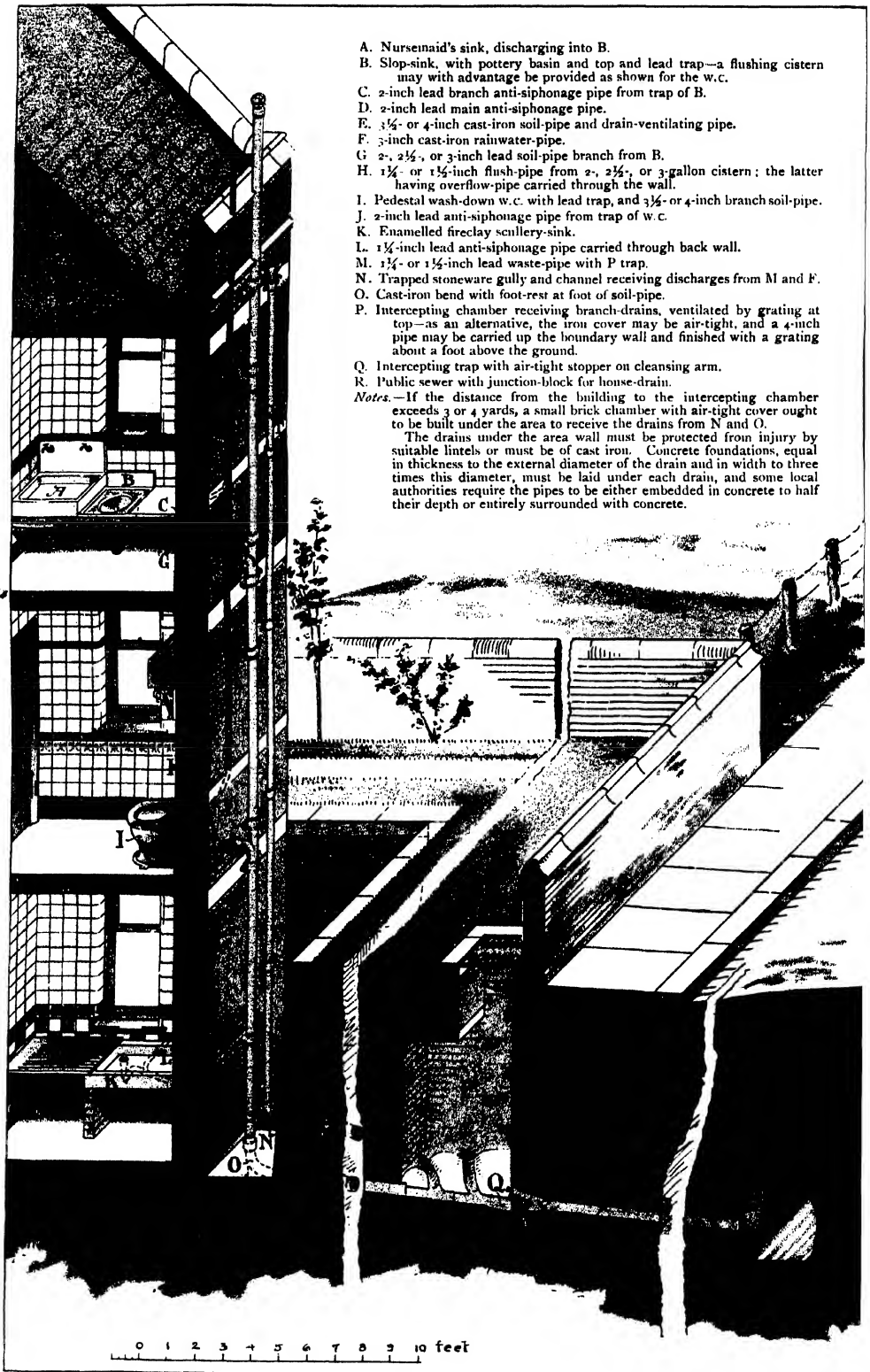
Chlorine is present in all drinking-water, and in much rain-water, but the chlorine in domestic sewage arises chiefly from common salt in the kitchen wastes and in urine. It has been estimated that, on the average, human urine amounts to about 40 ozs. per head daily, and that the chlorine in urine is about 500 parts per 100,000. The proportion in sewage of a domestic character varies very largely according to the degree of dilution, being in some cases more than 20 parts per 100,000, and in others less than 5; at Buxton, according to one analysis, it is only 2.3, and at Wolverhampton trade effluents raise it to more than 100.

As sewage is a foul liquid, often containing disease-germs, and always giving off emanations more or less injurious to health, the aim of sanitation is to remove it as quickly as possible, and to prevent all emanations from it entering our houses.

**Sanitary fittings** should be of such a character as to comply with these two principles. They should not retain filth, but should be easily kept clean, and should be so arranged that the entrance of foul air

from the drains and sewers is practically impossible. The principal sanitary fittings are the washing-up sink, the lavatory (or basin), the bath, the water-closet, the slop-sink, and urinal. The washing-up sink for ordinary purposes is often of stone, but as this material is absorbent, it is much better to adopt salt-glazed earthenware, and, for better work, cream-glazed or porcelain-enamelled fire-clay. Sinks for washing pans may be of galvanized iron, and those for crockery and glass may be of wood lined with lead or copper. The walls near a sink should be lined with glazed bricks or tiles, and the space beneath the sink should on no account be closed. The foul water should be conveyed away by means of a 'waste-pipe', usually of lead, and from 1½ to 2 inches in diameter according to the nature of the sink. In this waste-pipe, immediately under the sink, a bent pipe, known as a 'trap', must be placed; the water lodging in the bend of the trap prevents the entrance of air through the waste-pipe into the house. The outer end of the waste-pipe must not be connected directly with the drain, but must discharge over or near a drain-trap, so that air from the drain cannot enter the waste-pipe. As the water in a trap may sometimes be lowered by siphonage, or in some other way, to such an extent as to allow the passage of air through the trap, a ventilation-pipe is often inserted as shown at T,

# SEWAGE.



SANITARY FITTINGS AND DRAINS.



in Plate; this is also known as an 'anti-siphonage' pipe, because it prevents any of the contents of the trap being siphoned out. Washing-basins are usually made of some kind of porcelain, or, for rough usage, of enamelled fire-clay. Baths are made of various materials, but the most serviceable are of cast-iron, either paint-enamelled or porcelain-enamelled, or of porcelain-enamelled fire-clay. They should not be inclosed with woodwork, but should have either a roll formed around the top in the material itself, or a wood margin, the latter having the advantage of warmth. The water ought not to enter the bath through the waste-outlet, and the overflow ought to be so arranged as to be easily cleaned. As baths and lavatories are usually on an upper floor, their waste-pipes are often connected; where this is done, each trap must be ventilated by means of an anti-siphonage pipe, otherwise the discharge of waste from one fitting may draw the water out of the trap of the other fitting, and air, fouled by its passage through the dirty waste-pipe, will then enter the house. Water-closets are dangerous if improperly designed and fitted. Pan-closets are an abomination, and ought never to be used. Wash-out closets are also defective; the parts between the standing water and the trap soon become foul, and the discharge from an ordinary flushing cistern is insufficient to carry the soil through the trap and drain. There remain three types of closet—the wash-down, the valve, and the siphonic. For ordinary use the 'short-hopper' wash-down closet is as good as any; it should be of the 'pedestal' form—i.e. without wood inclosure,—should have a sufficient area of water to prevent soiling of the basin, and should have a flushing-rim and a separate cistern designed to deliver *not less* than 2 gallons at each flush. The form of closet shown in the plate has a lead trap; this can be turned in any direction, and allows a perfect connection to be made with the lead branch of the soil-pipe by means of a 'wiped' solder joint, but it would be much improved by having a larger area of water to receive the faeces. Usually closets of this type are made with the traps of enamelled fire-clay similar to the basin and often in one piece with it. Valve-closets are so called on account of the valve which closes against a seat under the basin and retains a quantity of water in the basin. When the valve is opened (usually by pulling a handle), the contents of the basin are discharged into the trap below, whence they pass to the soil-pipe. The valve-box should be ventilated, and a regulator must be fitted in connection with the flushing-cistern so that the necessary amount of water will be automatically supplied to the basin after the valve is closed. In the illustration the apparatus is shown entirely above the floor, a step being formed in front of the seat. Valve-closets are now made with white-ware inclosures instead of wood, and also in pedestal form. The most modern type of water-closet is on the principle of the siphon. The chief advantages are the large area of the water in the basin and the rapid discharge of the contents. The siphonic action may be started in different ways, but these need not be particularized. Some siphonic closets are uncertain in their action, and nearly all require a flush of 3 gallons. Each water-closet must have a cistern of its own, and must not on any account be flushed directly from the cistern used for the storage of water for domestic purposes. The cistern is usually of cast-iron or of wood lined with lead, but enamelled-earthenware cisterns can also be obtained; cast-iron rusts and stains the basin, and for ordinary use the lead-lined wood cistern is the best. At least 2 gallons of water should be discharged at each flush, but if the regu-

lations of the local water-company will allow, a flush of 2½ or 3 gallons should be provided. There are two principal varieties of cistern, the valve type and the siphonic; in the former the water is only discharged so long as the handle is pulled, while in the latter the pulling of the handle commences a siphonic action by which the whole contents of the cistern are discharged even if the handle is released. The siphonic cisterns are to be preferred. The cistern should be fixed about 5 ft. above the seat of the closet, and the flush-pipe should be 1½ or 1¼ inch in diameter. The supply to the cistern must be regulated by means of a ball-tap, and an overflow-pipe must be carried through the nearest wall. In exceptional cases, where the water will not rise to the height of the ordinary flushing cistern, a special cistern with large outlet may be fixed immediately above the seat of the closet. The soil-pipe may be of lead or cast-iron, opinion being divided as to the respective merits of the two materials. Lead soil-pipes should be solid-drawn, i.e. without seam, and the joints should be 'wiped' and the pipes adequately supported by means of lead tacks. Cast-iron pipes should be of ¾-inch metal at least, glass-enamelled inside or coated with Angus Smith's solution to prevent corrosion, and the joints should be made perfectly air-tight by means of gasket and lead well caulked into the space between the socket of one pipe and the spigot of the next; putty joints must *not* be used. A new kind of pipe has an outer shell of cast-iron and a lining of lead, and is designed to combine the advantages of the two materials. The internal diameter of the soil-pipe is usually 4 inches, but a diameter of 3½ inches is ample for even three or four closets, provided that the traps of the closets are properly ventilated as shown at J in the Plate. The trap-ventilating pipe, or 'anti-siphonage pipe' (as it is generally called), is often carried up inside the building, but it is better to fix it outside. The soil-pipe itself ought always to be fixed outside the building. In some cases it may be necessary to fix a trap at the foot of a soil-pipe, but as a rule the soil-pipe is connected directly with the drain and made to serve as a ventilating shaft for the system of drainage. In any case it must be carried above the roof of the building, the termination being as far as possible from all windows, skylights, and other openings. The free end may be protected by a copper-wire cage. In some districts slop-water closets are much used. These are flushed at irregular intervals by means of the dirty water from sinks or of rain-water from roofs. They are better than privies, but much inferior to proper water-closets, as the basins or (rather) soil-shafts are constantly fouled. In schools and factories ranges of closets or latrines are often fixed with one siphonic cistern for every range of four or six closets; the supply of water to the cistern can be regulated so that the cistern will discharge its contents automatically at long or short intervals. From the sanitary point of view the ordinary water-closet is to be preferred. Slop-sinks are intended for the reception of chamber-slops, and should be treated exactly as water-closets (see A, C, and G in Plate). They are unnecessary except in large houses, hotels, and other important buildings. In smaller houses the water-closet can be used for the purpose, if it is fitted with a hinged seat; a square porcelain top with a raised rim may be fitted under the seat of the closet in order to prevent the slops splashing on to the floor. A housemaid's sink is usually placed at the side of the slop-sink, so that utensils can be washed; the waste-pipe from the sink may be arranged to discharge into the basin of the slop-sink. Urinals are difficult to keep perfectly

clean and sweet, and therefore ought not to be fixed in houses. Urinals should be of impervious materials, and the waste-pipes should be treated as soil-pipes, but of smaller diameter. Every urinal should have an abundant supply of water, which may be arranged to discharge automatically at regular intervals from a cistern provided for the purpose. Every pipe for the conveyance of sewage from sanitary fittings ought to be exposed to view, in order that defects may be easily discovered and repaired. All sanitary fittings ought to be placed in properly lighted and ventilated rooms, but especially water-closets and other fittings intended for the reception of human feces and urine, and walls and floors ought also to be absolutely impervious. The ideal room for sanitary fittings will have one (at least) of its walls an external one provided with one or more suitable windows, all its walls lined with glazed bricks or tiles or finely plastered with cement and painted, its floor of concrete covered with tiles or other impervious material, and will be suitably ventilated, and also warmed so that there will be no danger of frozen pipes. If the room is in a wing of its own, separated from the main building by a passage lighted and ventilated on both sides, so much the better. Where an impervious floor cannot be obtained, a lead 'safe' may be placed under the fitting, but the waste-pipe from this must not be connected with the pipe from the fitting, but be made to discharge through the nearest wall, the end being fitted with a flap to prevent the entrance of air.

*Drains* may be defined as private conduits for the conveyance of sewage. They ought to be both airtight and water-tight. Leaky drains are a prolific source of disease in consequence of the pollution of air, soil, and water in the neighbourhood of dwellings. Drains are usually made of glazed earthenware or stoneware, or of cast-iron, the latter being the better material, on account of its greater strength and smaller number of joints; it is, however, more costly. The thickness of the metal in cast-iron drain-pipes from 4 to 6 inches in diameter is, as a rule, not less than  $\frac{3}{8}$  inch, and the joints should be caulked with gasket and lead. Before leaving the foundry the pipes should be coated with Angus Smith's solution to prevent corrosion. Cast-iron bends, traps, inspection-pipes, and other fittings can now be obtained in great variety. Earthenware and stoneware drain-pipes are usually circular, but egg-shaped pipes are also made. The method of jointing is the most important point to be considered. The ordinary method is simply to fill the annular space between the socket of one pipe and spigot of the next with clay or cement-mortar. Clay cannot be recommended, as it is liable to be squeezed out or washed away, and also to be penetrated by worms and the rootlets of trees. Cement-mortar is better, provided that the amount of sand mixed with the cement is not excessive. The diameter of drain-pipes may be much less than is popularly supposed. With the same flow of sewage, a small drain is almost invariably cleaner and sweeter than a large one. The reason is not far to seek. In the small drain the depth of the flow is greater; consequently there is, as a rule, a greater velocity of flow, with less risk of deposits forming in the drain. Thus, a 4-inch drain running half-full at a gradient 1 in 40 will have a velocity of about 172 feet a minute, whereas a 9-inch drain conveying the same amount of sewage at the same gradient will have a velocity of only 150 feet a minute. A small drain has the additional advantage of being easily and thoroughly ventilated. A 4-inch drain is large enough to take the sewage of a moderate-sized house, and very few mansions require a main drain larger than 6 inches.

Drains ought to be laid at such a gradient that the sewage will have a velocity of *not less than 2 feet per second*, or 120 feet per minute, with the normal depth of flow equal to one-fourth the diameter of the drain. To comply with this rule a 3-inch drain must have a gradient of at least 1 in 22, a 4-inch 1 in 36, a 5-inch 1 in 52, a 6-inch 1 in 70, a 9-inch 1 in 130, and a 12-inch 1 in 205. If the pipes and workmanship are not of the best, the gradients must be quicker. In places where sufficient fall cannot be obtained to render the drains self-cleansing, recourse must be had to a flush-tank arranged to discharge its contents automatically at regular intervals.

The amount of sewage in different localities varies according to the water-supply, the rainfall, ground-water, &c., but a common estimate is from 30 to 35 gallons per head per day. For detached houses, where baths are freely used, an allowance should be made of about 25 or 30 gallons a day for each person, horse, and carriage, and for a rainfall of  $1\frac{1}{2}$  or 2 inches per hour according to the locality. If ground-water enters the drains, the quantity must be ascertained and added to the sewage and rain-water. The sewage proper is discharged very unequally throughout the day, and it is customary to assume that one-half the total quantity will pass into the drains in about 4 or 6 hours. But this method of calculation, although accurate enough for sewers, is not satisfactory for drains. For example, for a household of eight persons we should, according to this basis of calculation, have about 200 gallons of sewage a day, of which 100 gallons would be discharged in, say, 4 hours, i.e. at the rate of 25 gallons an hour, or less than half a gallon a minute, but we know that a bath containing 40 or 50 gallons can be emptied in about 2 minutes, that is, at the rate of 20 or 25 gallons a minute, and a 2-gallon w.c. cistern can be emptied in about 6 seconds. Other sanitary fittings, such as sinks, may also be in use at the same time, and it is thus possible to have a flow at the rate of 30 or 40 gallons a minute. To this must be added the rainfall, which must be calculated according to the maximum intensity known in the locality and according to the area of the roofs and paved surfaces connected with the drains. On an impervious surface of 100 square yards a rainfall of 2 inches per hour will yield about 16 gallons a minute. The combined flow of sewage and rain-water in this case could not exceed 60 gallons a minute, and would not fill a 4-inch drain laid at a gradient of 1 in 40, for such a drain, when running full, is calculated to discharge 93 gallons a minute.

House-drains ought always to be disconnected from the public sewer, and the best way of effecting this is to place a trap in the house-drain as near the sewer as possible. A good plan is to fix the trap in an inspection-chamber or manhole, as shown at Q in the Plate. Every inlet to a drain, except those at the feet of soil-pipes used as ventilating-shafts, ought to be trapped, and all waste-pipes should discharge above the standing water in the trap. It is a good plan to let them discharge over a channel about 18 inches from the trap, so that the risk of drain-air entering the waste-pipe may be minimized. Special 'grease-traps' are made to receive the wastes from large scullery sinks. Rain-water pipes must be disconnected from drains by means of traps and grates, and must not be used either as ventilation-shafts or soil-pipes. Drains ought not to be carried into or under buildings if it can possibly be avoided. Cellars and wash-kitchens can, as a rule, be drained from an adjacent area. Sometimes, however, a drain must be carried under a building; in such a case strong cast-iron pipes should be used, and the drain

must, if possible, be absolutely straight from end to end. A free circulation of air must be maintained through the drain, and means of access must be provided at each end. If a bend is unavoidable, or if the drain is a long one, one or more air-tight cast-iron access-covers may be inserted at suitable points.

As it is of vital importance that there should not be any settlement of a drain, especially under buildings, drain-pipes ought to be laid on a concrete foundation if the ground is at all soft. A clear space ought to be left around drains where they pass through walls, otherwise a slight settlement of the walls will break the pipes or dislocate the joints. For drains passing under buildings, and under the foundations of walls, iron pipes should be used.

The ventilation of drains is a matter of primary importance, and is generally effected by providing air-grates at low levels and air-shafts carried above the roof. The most common arrangement is to place a perforated grate over the inspection-chamber nearest the sewer, and to utilize the soil-pipe near the head of the drain as the high-level opening. This arrangement is illustrated in the Plate. Sometimes the low-level opening is near the head of the drain, and the other near the sewer. Long branch-drains should be separately ventilated. It is often said that the temperature of drain-air is *always* higher than that of the atmosphere, and that consequently the drain-air will always be expelled through the lofty shaft. Experiments show that this is a very erroneous view. The temperature of drain-air is, in warm weather, usually lower than that of the atmosphere, and the theory based on the contrary assumption cannot therefore be sustained. Moreover, the movement of air in drains is influenced by barometrical pressure, the humidity of the outer air, the direction of the wind, and other causes. Unless some direct method of inducing a current, either by mechanical means or by heat, is adopted, the natural forces must be allowed free play, and the openings provided for ventilation must be so placed that no harm will be done if they act either as inlets or outlets. Sometimes a grating with mica flaps behind is fitted to form the air-inlet, the flaps preventing any back-current; this arrangement may be adopted if the grating is unavoidably near a window or door. Drains ought to be tested as soon as completed, and at regular intervals afterwards. Olfactory tests, such as pouring a solution of peppermint into the drain or into a fitting connected with it, are of little use. The smoke test is better, and is carried out by means of rockets or by forcing smoke into the drain from a machine. A positive test can be made by stopping the outlet of the drain and filling the drain with water; if the level of the water remains constant the joints are sound.

*Sewers* may be defined as public conduits for sewage. Small sewers are generally constructed of earthenware or stoneware pipes like drains, but in loose sandy soils cast-iron pipes are better. Stoneware pipes are now made up to 36 inches in diameter, but the largest sizes are seldom used. As a rule, sewers more than 2 feet in diameter are built of bricks laid in cement mortar. In cross-section brick sewers are now generally made egg-shaped (as at R), although the circular form is still adopted for small sewers. Many of the London sewers are built entirely of concrete. In other places, as at Southampton, sewers are of concrete and bricks. In bad ground the bottom of the trench must be covered with concrete to form a good foundation; the concrete should be carried up around the sewer to about half its height. Sewers in loose sand are sometimes carried on plank foundations or on piles.

Badly-ventilated sewers are a source of great

danger to the occupants of buildings connected with them. A sudden influx of water into the sewer will, unless adequate provision is made for ventilation, force the sewer-air through the traps of drains and eject it in the neighbourhood of the buildings, if not into the buildings themselves. That sewer-air is dangerous to health is a well-known fact. If inhaled for lengthened periods it appears to lower vitality and to render the persons breathing it more susceptible to infection by the microbes of certain diseases. It is often said that sore throats, diphtheria, and typhoid fever are directly caused by the inhalation of sewer-air, and this is probably true in many cases, but our knowledge of the subject is far from complete. However, it is of little consequence whether foul sewer-air is the direct cause of disease or merely a predisposing cause; in either case it is dangerous, and sanitarians are agreed that its foulness should, as far as possible, be prevented by constructing the sewers in such a manner that no deposits will be formed, and that the sewage will be removed before it has time to decompose to any serious extent. They are also agreed that ventilation is necessary, but they are not agreed as to the means to be adopted to secure it. The ordinary method is to fix perforated-iron covers on all manholes, but these, if the sewers are faulty, are often so great a nuisance that the neighbouring householders demand that the perforations shall be closed. Others advocate the fixing of shafts up the walls of buildings, believing that these will always act as extract-shafts and the manhole-covers as inlets; experiment has shown that this is a mistaken notion. Moreover, it is not everyone who will allow a sewer-ventilating shaft to be fixed to the wall of his building. A better method is to fix shafts in the streets, somewhat like lamp-posts, and to induce an upward current in these by means of burning gas; the sewer-air is purified by passing through the flame. Some have advocated the construction of a large central shaft, like a mill-chimney, the air to be drawn to it by means of a fan, but there are practical objections to such a scheme. Other inventors have attempted to purify the air of sewers by means of chemicals. Among appliances for this purpose we may mention Conder's ferrometer and the 'Reeves system of sewer ventilation'. The latter has been adopted in several towns with satisfactory results. By means of a solution of manganate of soda and suitable apparatus the manhole in which the apparatus is placed is—in the words of the inventor—'filled with a strongly oxidizing vaporous atmosphere which effectually purifies and deodorizes any upward flow of foul gases'. It is also claimed that the action of the vapour is not confined to the manhole, but extends throughout the adjacent sewers.

*Trade-refuse* in large quantities ought to be separately treated by manufacturers, and not allowed to pass into the sewers in its crude state, as it is often extremely foul and renders the treatment of the sewage at the outfall-works more difficult.

The principal systems of sewage disposal are as follows:—

- I. Discharge into the sea or river.
- II. Land-treatment.
- III. Precipitation, usually followed by filtration or land-treatment.
- IV. Biological treatment.

The discharge of sewage into the sea is permissible if the point of discharge is such that the sewage will not be brought back to the shore by the tides or by currents. The rivers of Britain are without exception too small to receive crude sewage without danger to the towns along the banks. Much has been written about the self-purification of rivers,

but the Irwell at Manchester, the Aire at Leeds, the Thames at London, the Tyne at Newcastle, and the Clyde at Glasgow are evidence that in this country at least rivers do not purify themselves to any great degree. It is true that flowing water will render innocuous a small amount of sewage, but the volume of sewage must be very small in comparison with the flow of the river. But if sewage is allowed to enter a stream at one place, why not at others? The only proper course is to prohibit entirely the pollution of rivers by foul matter.

Sewage may be utilized and purified on land in two ways. The first, known as *irrigation or broad irrigation*, consists in applying the sewage to farm-lands in such a manner as to utilize its full manurial properties in the production of crops; in the second, known as *intermittent filtration*, the purification of the sewage by filtration through land is the primary object, but advantage is also taken of the fertilizing properties of the sewage. Broad irrigation can only prove satisfactory on suitable soils, with suitable sewage, and where an area of land, large in proportion to the quantity of the sewage, can be obtained. The most suitable soils are those of a light sandy nature; stiff clays are quite unsatisfactory, unless carefully prepared. At Wimbledon the clay soil was ploughed up to a depth of 9 inches, and covered with screened ashes, so as to form when mixed a porous layer about a foot thick through which the sewage could pass *laterally* to the subsoil drains, which were laid at a depth of 6 feet. The porosity of the surface-layer was maintained by ploughing it every other year. Clay soils, however, are apt to crack in hot weather, and consequently the sewage passes without purification to the subsoil drains and thence to the ditches or streams with which these are connected. If a more suitable soil cannot be obtained it is better to adopt some other method of disposal than irrigation. Among the advantages claimed for irrigation the principal is that of economy; it is argued that sewage can be disposed of in this way not only without loss, but actually at a profit. This may be true for very light soils and for districts where suitable land is cheap and plentiful and where the sewage has not to be pumped, but experience has shown that under other circumstances irrigation is a costly process, and in many places it is absolutely impossible to obtain the necessary area of suitable land. The amount of land required for the purification of sewage by irrigation has been variously estimated, but it is usually considered that *at least* 1 acre of land should be provided for the sewage of 100 persons, and some authorities say that 2 or 3 acres should be provided for the same number of persons if the best results are to be obtained. The principal disadvantages of sewage-farms are the saturation of the soil until it becomes 'sewage-sick', the foul odours which are given off if the farms are badly laid out or badly managed, and the difficulty of dealing with large quantities of storm-water. Great care is necessary in preparing the surface of land for irrigation, in order that 'ponding' may be avoided. On flat ground the surface should be formed into shallow furrows and ridges; along the ridges, which are usually 10 or 12 yards apart, the sewage is brought in channels or 'carriers', over which it flows on to the slopes leading to the effluent channels in the furrows midway between the ridges. On sloping ground the sewage is brought in channels following the contour of the ground, whence it flows over the ground to channels at lower levels. It need scarcely be said that the sewage must not be applied continuously to the land, but the farm must be so arranged that the

sewage can be applied intermittently to the several parts as the state of the crops may require, and in order that saturation of any part may be avoided. The sewage of many manufacturing towns cannot be utilized on land without preliminary chemical treatment; thus, at Birmingham the sewage is treated with lime before being applied to the land. Intermittent filtration through land, like irrigation, is only successful if the soil and sewage are suitable. Light sandy soils are the best. It consists in filtering the sewage through land well drained at a depth of about 5 or 6 feet, the surface being usually formed into narrow ridges, with furrows about 18 inches deep between along which the sewage flows. Along the ridges, which should rise about a foot above the level of the sewage, vegetables or osiers are grown. This method of disposal has met with considerable success where care has been taken to give the land suitable periods of rest. An acre of land laid out in this way will purify the sewage from 250 to 1000 persons according to the nature of the soil and the care with which the sewage is applied. Every sewage-farm ought to have two or more beds for intermittent filtration, on which storm-water can be treated and on which surplus sewage can be turned when for some reason (such as the state of the crops) it cannot be disposed of by irrigation.

*Chemical precipitation* alone will not purify sewage satisfactorily. It may clarify it, deodorize it, and sterilize it to some extent, but it will not thoroughly purify it. Scores of different materials have been tried, but the one in most general use is lime. Other well-known precipitants are aluminio-ferrie, sulphate of alumina, and ferrozone. The most suitable chemical for a given sewage can, however, only be determined by experiment. The chemical is mixed with the sewage in the proportion found to give the best results consistent with economy, and the sewage is then allowed to flow into tanks. The tanks are usually of brick with concrete bottoms, and rectangular in shape, but many special tanks have been invented. They are generally three in number, so that one can be filled while another is being emptied and the third is being cleaned or repaired. Some engineers prefer that each tank when full should be allowed to stand for an hour or more, until the chemical has done its work and 'precipitated' as much of the solid matter as possible; others advocate the continuous-flow system, the sewage passing slowly through the tank and overflowing at the end farthest from the inlet. The precipitated matter in the bottom of the tank is known as 'sludge'; it is a foul mud containing about 90 per cent of water, and is a difficult substance to dispose of. It is generally run into a sludge-well, from which it is pumped to the surface. A preliminary draining process may then be adopted, part of the liquid draining off and joining the flow of sewage to the tanks. The remaining sludge is sometimes dug into adjacent land as a fertilizer, but more generally it is pressed by machinery into 'cakes', 1 ton of cakes being obtained from about 5 tons of sludge. The cakes are sold or given to farmers, or burnt in refuse-destructors. The sludge of London and Manchester is taken out to sea in barges. The effluent from the precipitation-tanks requires further treatment before it can be discharged into a river. This treatment may be by irrigation, or intermittent filtration through land or through artificial filters.

*Bacterial treatment.*—Filtration is partly a mechanical process, the larger particles in the sewage being strained out as if by a fine sieve, but it is principally a biological or bacterial process of purification, and can be most conveniently considered as a part of the fourth method of disposal,

which is variously known as 'biological' or 'bacterial' treatment, or, more conveniently, as 'biolysis'. For ages it has been known that manure spread over a field soon loses its foul character and eventually disappears, but only during the latter part of the nineteenth century has it been ascertained that this change is effected by countless minute organisms or bacteria, which have been aptly named 'Nature's scavengers'. Different kinds of bacteria are always present in sewage, and if they are allowed full play they will eventually convert the foul organic matter in the sewage into innocuous elements and compounds, much of the solid matter being eliminated in the form of gases. The bacteria employed in this work of purification are commonly divided into two classes: *anaërobic*, that is, those which perform their life-duties without air; and *aërobic*, which require air to enable them to do their work. 'To aërobic organisms are due:—(1) The conversion of urea into ammonia; (2) the conversion of ammonia into nitrate. To anaërobic organisms are due:—(1) The decomposition of cellulose and allied substances with evolution of marsh-gas; (2) the removal of oxygen from nitrates, with simultaneous oxidation of organic matter; (3) the decomposition of complex organic matter, with production of ammonia, hydrogen, &c.' (Experts' Report on Treatment of Manchester Sewage, 1899.) Among the pioneers in the application of the principles of bacteriology to the practical problem of sewage-purification the name of Scott-Moncrieff deserves mention. As long ago as 1892 he devised a system of purification without the use of chemicals or land-treatment, and practically demonstrated its efficacy on a small scale. The sewage from a house was led in its crude state (the grease only being kept back as much as possible by a grease-trap) to the bottom of a 'cultivation filter-bed', composed of flint, coke, and gravel, about 14 inches deep, through which the sewage flowed slowly upwards till it escaped at the overflow. The effluent from the 'cultivation filter-bed' passed along a 'nitrifying channel' filled with coke and exposed to the air. At this time the parts played by different bacteria were not known, but it will be observed that, whether by accident or design, Mr. Scott-Moncrieff had provided the conditions necessary for the development of anaërobic bacteria in the cultivation filter-bed, this being always filled with the sewage, and for the aërobic bacteria in the nitrifying channels. Further research showed that anaërobic bacteria will multiply in sewage without the aid of any filtering material, and this fact was put to practical use by Mr. Donald Cameron in his well-known 'septic' system of sewage-purification. In this system a covered tank takes the place of Scott-Moncrieff's cultivation filter-bed, and filter-beds of coke or other material are adopted in lieu of the nitrifying channels. The success of the system in many instances has been most striking. The amount of sludge deposited in the tank is extremely small; at Exeter it is about  $4\frac{1}{2}$  grains of dry solid matter for each gallon of sewage passed through the tank. The filters in the installation at Exeter are five in number, each having an area of 80 square yards and a depth of 5 feet; the filtering materials are broken furnace-clinker and coke. The flow of sewage is about 54,000 gallons daily from a population of 1500. The capacity of the tank is about one day's flow. Recent experiments at Manchester show that the tank may be left open without reducing the action of the anaërobic bacteria. It may be said, in passing, that a septic tank, either open or closed, may be used by anyone; the patents relate only to the apparatus for discharging the contents of the tanks.

Filtration is a most important part of the process. At Exeter each filter was filled with sewage and remained full till the next was filled; the outlet valve of the first was then opened and the purified sewage discharged. The thorough aëration of the filter is essential to the success of the process. This may be attained by the repeated emptying of the filter, and by allowing it some hours' rest every day and a clear day's rest every week. Filter-beds of this kind, which are allowed to fill with sewage, are usually known as 'contact beds', and were first used by Mr. Dibdin in his experiments with London sewage. Many filters have been designed with the view of obtaining thorough aëration with a continuous flow of sewage; among these may be mentioned Ducat's, Lowcock's, Waring's, Stoddart's, Whitaker and Bryant's, and (on a small scale) Scott-Moncrieff's. In Lowcock's filter, air is forced by a blower into the pipes about half-way down the filter, and escapes from these into the filtering material. The Manchester experiments show that the best results are obtained with double or multiple filtration, that is, by passing the sewage (after preliminary purification in tanks) successively through two or more filters. At Manchester the sewage was passed successively through two contact-beds at twice the ordinary speed (four fillings a day instead of two); this gave better results than two fillings a day with a single filter. Triple contact is now adopted at some sewage-works—Hampton, for example. The best filtering materials are cinders and coke, but sand, gravel, coal, &c., are also used. The size of the pieces is often graded from the bottom upwards, the finest being at the top, but there does not appear to be much advantage in this method. Probably pieces from  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch in diameter give the most satisfactory results. At Hampton the first contact-beds were filled with clinker rejected by a  $\frac{1}{2}$ -inch mesh; the second contact-beds with clinker passed by  $\frac{1}{2}$ -inch mesh and freed from dust; and the third contact-beds with clinker sand, but the result has not been of the best. The depth of filtering material for contact-beds may vary from about 3 feet to 4 or 5 feet. Some experiments carried out for the London County Council seem to show that the purification effected is directly as the depth of the filtering material. Larger material may be used for percolating filters, and the depth may be from 5 to 9 feet. It may be added that the filtration of crude sewage without preliminary tank-treatment has been attempted, but hitherto without success, as the filters gradually become choked. There is now no doubt that bacterial purification of sewage is possible, and as it possesses many advantages over other methods of treatment, and strictly conforms to natural laws, it will probably soon be more generally adopted. For the sewage of isolated buildings it is particularly adapted. The sewage can be run into an underground tank or cesspool—which must be absolutely water-tight—and the overflow from this can be treated on land or by passing through artificial filters. That it is also suitable for purifying large volumes of sewage is shown by the experiments at Manchester and elsewhere. The three experts—Messrs. Baldwin Latham, Percy F. Frankland, and W. H. Perkin—who were instructed by the Corporation of Manchester to report on the best method of purifying the sewage of the city, unanimously decided in favour of the bacterial system; and Dr. Rideal confidently expects that the conclusions of the Royal Commission, which is now considering the subject of sewage-purification, will 'establish the safety of embarking on the treatment of sewage on bacterial lines for even the largest centres of population'.

**SEWARD, WILLIAM HENRY**, an American statesman, born at the small town of Florida, Orange county, New York, May 16, 1801; died at Auburn, Cayuga county, in the same state, Oct. 10, 1872. Having studied for the law he began practising at Auburn in 1823, but soon indicated a decided bent for politics, which gradually drew him away from the legal profession. In 1830 he was elected to a seat in the New York Senate, and from that date he may be said to have been, with few intervals, in one form or another, an effective and prominent leader in the councils that framed the policy both of his own state and of the nation. In 1838, and again in 1840, he was elected governor of his native state, and in 1849 he was elected for the first time a member of the United States Senate. He was the friend and adviser of President Taylor, and distinguished himself by his firm resistance to the extension of slavery. He opposed the compromise of 1850, by which California was admitted as a non-slaveholding state into the Union, but extensive concessions were made to Texas, and the rendition of fugitive slaves was sought to be secured by stringent provisions. In a speech at Rochester in 1858 he declared that the antagonism between freedom and slavery is an irrepressible conflict between opposing and enduring forces. In 1860 he was a candidate for the presidency, but being defeated in the Republican Convention by Abraham Lincoln, he exerted himself to secure Lincoln's election. In return for this assistance Lincoln on his election nominated Mr. Seward to the post of secretary of state for foreign affairs. The civil war which broke out soon after between the North and South rendered the duties of this office particularly arduous and critical, but they were discharged by Seward with signal energy and ability, though in some cases also with a good deal of arrogance. Seward continued to act as foreign secretary during the second term of Lincoln's presidency, and in April, 1865, when Lincoln was assassinated, he narrowly escaped the same fate at the hands of another assassin. He was dangerously wounded, but recovered from his wound, and continued to hold the same office under Lincoln's successor, Andrew Johnson. He retired from office on the accession of President Grant in March, 1869. A great part of the remainder of his life was spent in a tour round the world completed in the autumn of 1871. The *Speeches, State Papers, &c.* of Seward were published at New York in four vols. (1853-62), and his diplomatic correspondence from 1861 to 1869 has also been published. He was likewise the author of a life of John Quincy Adams (New York, 1849), and *Travels around the World* (New York, 1873). In 1891 his son, F. W. Seward, published an account of his life, partly autobiographical, in three volumes. See also the work on him in the *American Statesmen* series by T. K. Lothrop (1895).

**SEWING-MACHINES.** The first attempts to devise machines for replacing hand labour in sewing are as old as the present century. The first machines were contrivances for imitating mechanically the movements of the hand in sewing. In the machines of Thomas Stone and James Henderson (1804) there were two pairs of pincers, one of which seized the needle below and the other above the cloth, and pulled it quite through on either side alternately. In 1834 one Heilmann exhibited at Paris a machine which was then considered admirable, and in which the needle had the eye in the middle and a point at each end, which saved the necessity of reversing the needle every time it was made to traverse the material to be sewed. This machine was intended for use in embroidery. The slow working of the needle in it was compensated by the fact that a great num-

ber of needles were simultaneously employed in it. This machine as improved by Houldworth was guided by a pantograph, and required the attendance of five women. Previous to this (in 1830) Thimmonier and Ferrand had succeeded in contriving a machine producing what is known as the chain-stitch, which is made by means of a needle hooked at the end, which, passing through the material, seizes the thread below and pulls it up in the form of a loop, then pierces the material again a little in advance of the former point, and catches up a new loop, which it engages in the former, and so on. The great disadvantage of this stitch is that the whole seam becomes undone if the end of the thread is pulled. In 1854 Singer, an American, appeared with a machine calculated to remedy this defect of the chain-stitch by means of a mechanism for tying a knot in the seam at every eighth stitch. But long before the invention of Singer's machine another American, Elias Howe, a poor mechanic, ignorant of the attempts that had previously been made with the same object, had invented the first really satisfactory sewing-machine. He obtained his first patent for it in May, 1841, for America, but a good many years elapsed before it became widely known and largely used, as it ultimately did. Howe's machine used two threads, one of which passed through the eye of the needle, while another was contained in a small shuttle; and it produced a seam in which each stitch was firmly locked, so that it could not come undone by pulling. It was not the first that did this, for one of this nature had previously (1834) been patented by Walter Hunt, also an American, but it was the first that proved to be of any real use. Many improvements have since been made by other inventors. The principle of the two threads and the lock-stitch has been adhered to in most of the machines that have been invented subsequently to that of Howe, but various details applying that principle have been altered for the better. The chief objections to the Howe machine were that it was very noisy, owing to the movement of the shuttle, and that as the shuttle was necessarily small it had frequently to be re-filled with thread; and the most important improvement in the construction of double-thread sewing-machines is one that obviates both these inconveniences by dispensing with the shuttle altogether. In the Wheeler-and-Wilson machine, which is of this nature, the place of the shuttle is supplied by a reel which revolves in a vertical plane within a round piece of mechanism so contrived as to form a loop with the reel-thread, which becomes interlocked with that held by the needle. Of single-thread machines the best is that of Wilcox and Gibbs, which, while it is easy, quick, and noiseless in working, makes a securer stitch than all other one-thread machines. Of the numerous other machines that have been invented, and each of which proclaims itself superior to all others, some are better adapted for certain kinds of work than others. Some are fitted for heavy work, and others for light. Some are intended only for a special kind of work, as for sewing on buttons or sewing button-holes. Most sewing-machines are worked by a pedal, but many are worked by the hand, and some may be worked by either. For the heavier kinds of work steam is sometimes employed to work them, and for the lightest kind of work a machine has been invented which is driven by electricity, the hand being necessary only to direct the work of the needle. America, which is entitled to be regarded as the birthplace of the sewing-machine, and has produced most of its improvers, is still the place where its manufacture is most extensively carried on, and the number of machines which it produces annually is said to be enormous. In Great

Britain also considerable numbers are made—chiefly in or near Glasgow.

**SEX.** In the majority of animals and in many plants there are separate sexes—males and females. These differ primarily in reproductive function, the males producing spermatozoa, the females producing ova; but there are often, if not always, differences in the details of the constitution of the two sexes, both as to structure and as to habit. Every possible gradation occurs from males and females so like one another, as in sea-urchins, most bivalves, many fishes, &c., that only a careful examination of the reproductive organs is decisive, to males and females so different from one another, as in some birds, insects, spiders, worms, &c., that they have sometimes been referred to different species! In other words, sexual dimorphism may be very slight or very marked.

Although the occurrence of separate sexes, or the dioecious state, may be said to be typical, among animals at least, hermaphroditism, or the combination of the two primary sexual functions in one organism, is also very common. Many familiar animals, such as earthworm and leech, snail and ascidian, are normally hermaphrodite, and the same is true of a few fishes (*Chrysophrys*, *Serranus*). In some species of toad (e.g. *Bufo cinereus*) the males seem always to have a small ovary in front of the testes; but above this level there is never more than either casual or very partial hermaphroditism. It is very rare for a hermaphrodite to produce eggs and sperms at the same time; and usually the male or sperm-producing function comes into operation before the female or egg-producing function (*protandry* as opposed to *protogyny*). Thus, in the fish known as the hag (*Myxine*), specimens below a certain size have a functional testis and an immature ovary, while in larger older forms there is a functional ovary and a degenerate testis. Though this 'dichogamy', as it is called, is frequent, self-fertilization or 'autogamy' is not unknown; it occurs in many flukes and tapeworms, in not a few threadworms, in all probability in the interesting fish *Serranus*, and in some other cases. Darwin found in a number of barnacles and acorn-shells that the normally hermaphrodite individuals carried minute, often degenerate, 'complemental males' concealed under their shells; and a similar occurrence has been described in the strange *Myzostomata* which form galls on Crinoids. In not a few normally hermaphrodite threadworms there are occasional males, sometimes one in a thousand, which are remarkable in having lost all sexual appetency; in Rotifers also, where parthenogenesis has become the rule, there are sometimes rare males which seem to be quite ineffective sexually.

To the question, 'What determines whether a fertilized ovum will develop into a male or into a female organism?' many answers have been given, but there is no single answer that can be called satisfactory. In all probability, the determination is in most cases due to numerous factors which may co-operate with some consistency, or may in other cases counteract one another. It seems impossible at present to place confidence in any theory which emphasizes only one factor. The original protoplasmic organization of the ova and sperm-cells, their relative ripeness when they come together in fertilization, the relative age and vigour of the two parents, the nutritive conditions of the embryo on to the period (which differs greatly in different organisms) when the future sex is definitely fixed—these are among the important factors determining sex. We know that drone-bees arise from eggs which are not fertilized, while queens and workers arise from fertilized eggs, and that the reproductive

capability of the queens as contrasted with the normal sterility of the workers is in great part due to differences of diet during the larval stages. We know that the number of females to be got out of a hundred newly-hatched tadpoles can be altered at will by changing the diet, for a state of indifferent sex or embryonic hermaphroditism lasts for a long time in the case of the frog. We know that in other cases, e.g. some Rotifers and Nematodes, the sex of the offspring is predetermined in the development of the parent! These and a hundred other facts lead us to conclude that a theory of the determination of sex is still premature.

The frequent conspicuousness of sexual dimorphism, e.g. between man and woman, between stag and doe, between peacock and pea-hen, and so on through the long list, tends to lead us to an exaggerated view of sex differences. But there is another series of facts to be considered. Males and females seem often practically identical, except as to the reproductive organs, until the analysis becomes very precise; a female organism may produce eggs which, without fertilization, develop into males (e.g. the queen-bee); hermaphroditism occurs frequently and in all possible degrees from the most intimate combination of male and female functions to a superficial blending of masculine and feminine characters; the sex may practically change in the course of a lifetime, as in the hag (*Myxine*); slight alterations in nutrition, as in the case of tadpoles, may throw the balance to one side or the other during the period before the future sex is definitely determined; removal or disease of the essential reproductive organs may markedly affect the most conspicuous secondary sexual characters, thus a female deer with ovarian disease may grow antlers, or a castrated young male may have none; there is usually a close structural resemblance between males and females even as regards the essential reproductive organs and their ducts, which are undoubtedly built upon the same plan; even in regard to superficial characters the differences of sex are rather differences in degree of development than differences of kind, thus a male mammal has not only rudimentary nipples, but may occasionally give milk!

These and other considerations suggest the view that the difference between the sexes is primarily a functional one, that it depends upon a slight bias of the general trend of metabolism to one side or the other, that it corresponds to what might be called, in mechanical language, a difference in 'gearing'. This originally slight difference in protoplasmic organization, or in the trend of protoplasmic metabolism, may finally express itself in markedly different structures adapted to the habits of the two sexes, and may saturate through and through the organism down to its minutest details. A woman is feminine, a man is masculine, even in the heart-beats and in the temperature of the blood.

If we think of the chemical changes (metabolism) in a living body as consisting on the one hand of constructive, assimilative, *anabolic* processes, and on the other hand of disruptive, dis-assimilative, *katabolic* processes, we may say that females are relatively more anabolic, and males relatively more katabolic. But given this alternative, as implied in the very nature of protoplasmic change, we have to look to the environment (in the widest sense) to give the bias towards the one side or the other, and we have to look to the process of natural selection to work out the detailed adaptations characteristic of the two sexes. There seems no way out of the conclusion that each organism has at the beginning of its life an inheritance of both male and female characters, that various influences decide whether the



**SEYCHELLES**, a group of islands in the Indian Ocean, belonging to Great Britain, governed since 1888 by a separate administrator, between lat.  $3^{\circ}40'$  and  $5^{\circ}35'$  s., and lon.  $55^{\circ}15'$  to  $56^{\circ}$  E. They number over thirty, but many of them are mere rocks; the largest is Mahé, 17 miles long and 4 to 7 broad. They are mostly composed of granite piled up in huge masses, and terminating in peaks, in Mahé rising to 2900 feet. Most of them are covered with verdure, and yield good timber for ship-building or cabinet-work. The principal products raised are vanilla, coffee, coconuts, cocoa-nuts, spices, tobacco, maize, &c., besides tropical fruits and vegetables. The capital, Victoria, has a good harbour, and is a coaling station. The settlers are mostly of French extraction, and Roman Catholics. The Seychelles were first partially explored by Picault in 1743, soon after which a few French settlers established themselves on Mahé. In 1794 the British captured the islands, which were ceded to them at the peace of 1814. Pop. about 20,000.

**SEYMOUR**, a noble English family of Norman origin. Their name is corrupted from St. Maur, which was their seat in Normandy. They acquired lands in Monmouthshire in the beginning of the thirteenth century, and early in the fifteenth century added to these estates others in Somersetshire by marriage with an heiress of the Beauchamp family. The first individual member of this family to become conspicuous was SIR JOHN SEYMOUR, the father of the third wife of Henry VIII. and of Edward Seymour, protector of the realm of England during the minority of Edward VI., whose uncle he was. This Edward had been raised to the peerage by the title of Viscount Beauchamp on the marriage of the king with his sister in 1536, and the following year created Earl of Hertford. He commanded in a maritime expedition against the Scots in 1544, when he landed a body of troops at Leith, and set fire to the city of Edinburgh. By the will of Henry he was nominated one of the council of regency during the minority of Edward VI.; but, not content with his share of power, he procured himself to be appointed governor of the king and protector of the kingdom (January, 1547). In the month following he obtained the post of lord-treasurer, was created first Duke of Somerset, and made earl-marshal. The same year he headed an army, with which he invaded Scotland, and after having gained the victory of Musselburgh returned in triumph to England. His success excited the jealousy of the Earl of Warwick and others, who procured his confinement in the Tower in October, 1549, on the charge of arbitrary conduct and injustice; and he was deprived of his offices and honours, and heavily fined. But six months after he obtained a full pardon from the king, and a little later was admitted at court, and ostensibly reconciled to his adversary, Lord Warwick, whose son espoused one of his daughters. The reconciliation was probably insincere, as Warwick, who had succeeded to his influence over the young king, caused Somerset to be again arrested, in October, 1551, on the charge of treasonable designs against the lives of some of the privy-councillors. He was tried, found guilty, attainted, and beheaded on Tower Hill in January, 1552. His eldest son by his second wife was created by Elizabeth Earl of Hertford, and the grandson of this Earl of Hertford having distinguished himself in support of the royal cause during the parliamentary war, obtained in his favour the revival of the title of Duke of Somerset, and he took his seat in the House of Lords as second duke in 1660. On the extinction of his line the descendants of the first Duke of Somerset by his first wife claimed the title, and on the advice of the attorney-general that claim

was pronounced good by the House of Lords, in which body the descendants of that claimant still hold a place.

**SEYMOUR, JANE.** See HENRY VIII.

**SEYNE**, LA, a seaport town in France, in the department of Var, 4 miles south-west of Toulon. It is agreeably situated and generally well built, and has a small harbour, which is much frequented by the neighbouring coasters; an extensive ship-building yard, and a fishery. Pop. (1898), 9569.

**SFORZA**, a celebrated Italian house, which played an important part in the fifteenth and sixteenth centuries, gave six sovereigns to Milan, and formed alliances with most of the princely houses of Europe. The founder of the house was a peasant of Cotignola in Romagna, GIACOMUZZO (Giacomo or Jacopo Muzio) ATTENDOLO, whose skill and courage made him one of the most powerful *condottieri* of Italy. His surname of Sforza, which vouches for his great strength, he is said to have received from Alberigo Barbiano, the true founder of the condottiere mode of warfare in Italy. He served in the wars in the Papal States, in Tuscany, and in Naples, and died as Grand-constable of Naples in 1424. To his equally valiant son FRANCESCO (born in 1401) he left, with a body of devoted followers, a power which made him formidable to any of the Italian states. Francesco became the son-in-law of Philip Maria Visconti, duke of Milan, and received the command of the Milanese forces in the war against Venice. After the death of his father-in-law (1447) he laid claim to the states of Milan in virtue of his wife, although she was only the natural daughter of the last duke, and to enforce his claim concluded a treaty with Venice, and advanced against Milan. He laid siege to the city in 1449, and on the 8d of March, 1450, it was forced by famine to surrender. A few weeks later he was proclaimed duke, and he governed his dominions well and prosperously till his death on the 8th of March, 1466.

His son GALEAZZO MARIA (born 1444), a barbarian and a voluptuary, was murdered by some conspirators in 1476.—The son of Galeazzo, GIOVANNI GALEAZZO (born in 1468), nominally succeeded his father, but never actually ruled. Till 1480 he was subject to the guardianship of his mother and her minister Checco Simonetta. The latter was then beheaded by his uncle Lodovico, surnamed the Moor (il Moro, born in 1451). Lodovico then assumed the government himself, and kept his nephew virtually a prisoner in the castle of Pavia, where he died (perhaps by poison) in October, 1494. In the previous year Lodovico had formed a connection with Charles VIII. of France, to whom, in the summer of 1494, he opened the passage through Italy to Naples, with the view of preventing Giovanni's father-in-law, Alphonso, king of Naples, from rendering assistance to his son. At a subsequent period he joined the league against France, and was on that account deposed by Louis XII. (1499). By the help of the Swiss he expelled the French in the same year; but Louis again took the field against him, and prevailed upon the Swiss in his service to refuse to fight against their countrymen in the French ranks. Lodovico was afterwards betrayed by one of his Swiss mercenaries to the king, who (1500) carried him to France, where he died at Loches in 1510.

His son MASSIMILIANO (born in 1490) once more drove the French from his territories by the aid of the Swiss, but in consequence of the battle of Marignano was obliged to cede his dominions to Francis I. (1516) in consideration of a pension. The remainder of his life he spent in France, where he died in 1550. Francis was afterwards driven from Italy by the Emperor Charles V., who invested FRANCESCO (born

1492), brother of Maximilian, with the Duchy of Milan in 1529. On the death of Francesco in 1535 Charles V. conferred the duchy on his son Philip II., king of Spain. See MILAN.

S'GRAVESANDE. See GRAVESANDE.

SHAD (*Alosa*), a genus of Teleostean Fishes, allied to the Clupeidae or Herrings, and including two species, the Common or Allie Shad (*Alosa vulgaris*) and the Twaite Shad (*A. Antea*). The Common Shad inhabits the sea near the mouths of large rivers, and in the spring ascends them for the purpose of depositing its spawn in the shallow water about their sources. The young fry remain for a season in the waters which gave them birth, but on the approach of cold weather descend the rivers and take refuge in the ocean. The old ones likewise return, and at this time are emaciated and unfit for food. The form of the shad is the same as that of the other herrings—very much compressed, with the abdomen gradually becoming thinner, and forming a serrated edge; and, like them, the bones are much more numerous and more slender than in other fish. It is of larger size than the herrings, and in some places receives the name of 'Herring King.' Its colour is a dark blue above, with brown and greenish lustre, the under parts being white. The Twaite Shad is about a half less than the common species, and weighs on an average about 2 lbs. A deep notch exists in the centre of the upper jaw of both species. An American species of shad weighs from 4 to 5 lbs., but sometimes 12; the scales are easily detached, when a row of dark spots is exposed on each side. It is highly esteemed for food, and is consumed in great quantities in the fresh state. During the season they are an important source of wealth to the inhabitants of the borders of the Hudson, Delaware, and Chesapeake. Great quantities are salted, but are less esteemed than when eaten fresh.

SHADDOCK (*Citrus decumana*), a large species of orange, attaining the diameter of 7 or 8 inches, with a white, thick, spongy, and bitter rind, and a red or white pulp of a sweet taste, mingled with acidity. It is a native of China and Japan, and was brought to the West Indies by a Captain Shaddock, from whom it has derived its name. A full-sized shaddock is sometimes called *pompelmoose*.

SHADOW, the darkness caused by the interposition of an opaque substance between a luminous point or body and the place upon which the shadow is thrown. When the substance that casts the shadow is in open space, the form of the shadow is that of a section of the substance made at right angles to the direction of the ray of light. The limits of the shadow are clearly defined when the illuminating body is merely a single point, and when the substance casting the shadow is so situated that the light shed around it escapes the influences of dispersion, refraction, and reflection (see these articles); but when this is not the case the boundary between the light and the darkness is not so clearly marked, the one fading gradually into the other. It is obvious that when the illuminating body is not a mathematical point some parts of the space on which the shadow is thrown will receive light from some points of that body and not from others, so that they must appear in shadow, but not so deeply as the middle portions. This border shadow is called *penumbra* (which see). When the body casting the shadow is larger than that which emits the light the shadow goes on constantly increasing in diameter the further it goes; when it is of the same size with the latter, the shadow is unlimited in length, but always remains of the same diameter; and when it is smaller the shadow gradually diminishes to a point, where it terminates.

SHADWELL, THOMAS, an English dramatic poet, was born at Stanton Hall, Norfolk, a seat of his father's, in 1640, educated at Cambridge, and afterwards placed at the Middle Temple, where he studied the law for some time, and then visited the Continent. On his return from his travels he applied himself to the drama, and wrote seventeen plays. His model was Ben Jonson, whom he imitated in drawing numerous characters, chiefly in caricature, of eccentricities in the manners of the day. Although coarse and of temporary reputation, the comedies of Shadwell are not destitute of genuine humour. At the revolution he was created poet-laureate on the recommendation of the Earl of Dorset; and as he obtained it by the dispossession of Dryden, the latter exhibited the bitterest enmity towards his successor, against whom he composed his severe satire of Mac Flecknoe. He died December 6, 1692, in consequence, it is supposed, of taking too large a dose of opium, to the use of which he was addicted. Besides his dramatic writings he was author of several pieces of poetry of no great merit. The best edition of his works was printed in 1720 (four vols. 12mo).

SHAFTESBURY, a municipal borough and market-town of England, in the county of Dorset, on the edge of a high ridge, commanding extensive views, 28 miles N.N.E. of Dorchester. It is an old town, and once had a famous abbey, of which a few traces still remain. Besides churches, chapels, and schools, there are in the town a town-hall, hospital, alms-houses, and other charities. It is the centre of a good agricultural district, and manufactures agricultural implements. It is becoming known as a health resort. It was a parliamentary borough till 1885. Pop. in 1891, 2122; in 1901, 2027.

SHAFTESBURY, ANTHONY ASHLEY COOPER, FIRST EARL OF, a statesman of considerable eminence in the reign of Charles II., was born at Wimborne St. Giles's, in Dorsetshire, in 1621. He succeeded to a baronetcy on the death of his father in 1631. At the age of fifteen he entered Exeter College, Oxford, whence he removed to Lincoln's Inn, with a view to the study of the law; but was chosen representative for Tewkesbury in 1640, while only in his nineteenth year. At the commencement of the civil war he sided with the king's party, though he appeared to deem mutual concession necessary. Finding himself in consequence of this opinion distrusted by the court he went over to the Parliament, from which he received the command of the parliamentary forces in Dorsetshire. When Cromwell turned out the Long Parliament, Sir Anthony was one of the members of the convention which succeeded. He was, nevertheless, a subscriber to the protestation which charged the Protector with arbitrary government, a fact which did not prevent him from becoming one of his privy-council. After the deposition of Richard Cromwell he was privately engaged in a plan for the restoration of Charles II., which he subsequently aided with all his influence. He was one of the twelve members of the convention of 1660 who carried the invitation to the king, and was soon after made a privy-councillor, and a commissioner for the trial of the regicides. In 1661 he was raised to the peerage by the title of Baron Ashley, and appointed chancellor of the exchequer and a lord of the treasury. Yet he gave his strenuous opposition to two of the leading measures favoured by the crown, the Corporation Act in 1661, and the Act of Uniformity in 1662. Afterwards his conduct changed, and he was one of the members of the obnoxious Cabal. He supported the Dutch war, and issued illegal writs for the election of members of Parliament during a recess, and in 1673 supported the Test Act. In 1672 he was created Earl of Shaftesbury and lord high-cha-

cellor. His conduct on the bench was able and impartial. He had not, however, been a whole year in office when the seals were taken from him, probably through the influence of the Duke of York; and from that moment he became one of the most powerful leaders of the opposition. For his warmth in asserting that a prorogation of fifteen months amounted to a dissolution of Parliament he was committed to the Tower, and remained in confinement there from Feb. 1677 to Feb. 1678, not being released till he had made a full submission. After his liberation he made use of the Popish Plot to force out the Earl of Danby's administration (1678), and produce the formation of a new one, in which he was himself made president of the council (1679). Amid many violent party proceedings which followed he was the author of that bulwark of liberty, the Habeas Corpus Act. He only remained in the administration four months, when the interest of the Duke of York once more prevailed against a statesman whose endeavours to promote a bill for his exclusion from the succession had been unremitting. In his hostility to the Duke of York Shaftesbury is now supposed to have entered into connection with the Duke of Monmouth, with the view of supporting his claims to the crown, a circumstance which gave rise to Dryden's satire of Absalom and Achitophel. In consequence of this suspected design Shaftesbury was once more committed to the Tower, and tried for high treason; but the grand-jury before whom the bill of indictment was laid ignored it, amidst prodigious acclamations of the people. Not long after this acquittal the earl withdrew to Holland, where he arrived in November, 1682, and where he died of gout in the stomach, on the 22d of January, 1683. The career of this able, but dubious and versatile statesman, forms the best commentary on his public principles, and declares him to be rather a bold, active, and enterprising man of expediency than a great politician. Yet the character of a man sincerely esteemed by Locke, and other men of undoubted principle, is not to be taken without qualification from the representations of opposing party feelings. On the whole, this extraordinary person appears to have had many vices, somewhat redeemed by a great portion of ability, and a leaning to broad and liberal principles, when he could freely display them.

**SHAFTESBURY, ANTHONY ASHLEY COOPER,** THIRD EARL OF, grandson of the preceding, a celebrated philosophical and moral writer, was born at Exeter House, in London, in February, 1671. He was early instructed in Greek and Latin by a lady who spoke those languages with considerable fluency. He could read them both with ease when only eleven years of age. In 1693 he became the representative in Parliament of Poole, in Dorsetshire, and distinguished himself while in Parliament by his support of measures favourable to public liberty. His health suffered so much by Parliamentary attendance that in 1698 he gave up his seat, and visiting Holland in the assumed character of a student of physic, he prosecuted his studies, and became intimately acquainted with Bayle, Le Clerc, and other literary men. In 1708, in consequence of the extravagances of the French prophets, he published his *Letter on Enthusiasm*. In 1709 he published an *Essay on the Freedom of Wit and Humour*, an *Inquiry concerning Virtue or Merit*, and *The Moralist*, a Philosophical Rhapsody, being an eloquent defence of the doctrine of a Deity and providence. His *Sensus Communis*, and his *Soliloquy*, or *Advice to an Author*, followed in 1710; after which his health declined so rapidly that he was advised to fix his residence at Naples, in which city he died on the 15th of February, 1713. At the time of his death he was engaged on a work

on the Arts of Design. His works were collected and published together, under the title of *Characteristics of Men, Manners, Opinions, and Times*. A new edition began to appear in 1869. In 1716 some of his private letters upon philosophical and theological subjects were published, under the title of *Several Letters written by a Noble Lord to a Young Man at the University* (8vo); and in 1721 another collection, entitled *Letters from the Right Honourable the Earl of Shaftesbury to Robert Molesworth, Esquire, &c.* As a writer he is remarkable for the elegance but also for the excessive artificiality of his style. In the opinion of Sir James Mackintosh the *Inquiry concerning Virtue* is free from this fault. He also thinks it 'entitled to a place in the first rank of English tracts on moral philosophy,' inasmuch as 'it contains more intimations of an original and important nature on the theory of ethics than perhaps any preceding work of modern times.' (See *Dissertation Second* prefixed to *Encyc. Brit.*) In all his works Lord Shaftesbury appears a zealous advocate for liberty, and a firm believer in the fundamental doctrines of natural religion; but, although he professed a respect for Christianity, he was doubtless sceptical in regard to revelation, and sometimes indulged his humour on scriptural points with the greatest indecorum.

**SHAG** (*Phalacrocorax graculus* or *cristatus*), the common name of the Crested or Green Cormorant, possessing a green plumage, and averaging in length about 26 or 27 inches. This bird resembles the common species in habits, but is of less size. The nest is usually found on rocky ledges, and is made of roots and stalks of sea-weed, lined with grass. The dark green colour of the body is pleasantly relieved by the quills of the wings and tail, which are black. The young birds have a brownish tint amid the green plumage, with brown and white under surfaces.

**SHAGREEN** (in the Levant, *Saghir*), a kind of grained leather, of a close and solid substance, used for forming covers for cases, &c., which easily receives different colours. It is prepared in the East from the skins of wild asses, horses, and camels. The hinder back piece of the hides of these animals is cut off just above the tail and around the loins, in the form of a crescent. The piece thus separated is soaked several days in water till the hair drops off. It is then stretched, and the hair and epidermis are removed with a scraper. After a second soaking the flesh side is scraped in a similar manner; the skins are then stretched on wooden frames, and the hair side is covered with seeds called *allabuta*, probably those of the *Chenopodium album*, or goose-foot. The seeds are then trodden into the leather, which being dried and freed from the seeds, is left full of indentations, which produce the grain of the shagreen. The dried skins are then scraped with a piece of sharp iron till the inequalities are removed, and soaked again for twenty-four hours; the parts where the impressions of the seed were produced are thus swollen and raised above the scraped surface. The skins are next immersed in lye, and are ready to receive their colour. The most common colour is sea-green (given by means of copper-filings and a solution of sal-ammoniac); but blue, red, black, and other colours are also given it. Shagreen is also made of the skins of the sea-otter, seal, &c.

**SHAH**, in Persian, signifies 'king;' whence *Shah-naméh* ('book of kings'). See **FIRDOUSI**, and **PERSIA**, division Literature; see also **PADISHAH**.

**SHAH JEHAN**. See **INDIA**—History.

**SHAHJEHANPUR**, a town in India, in the North-West Provinces, 95 miles north-west of Lucknow, in the executive district of the same name.

There is a cantonment at the place, and sugar-works in the neighbourhood. Pop. in 1901, 75,662.

SHAKE, in music. See TRILL.

**SHAKERS**, or **SHAKING QUAKERS**, a sect which arose at Manchester, in England, about 1747, and has since been transferred to America, where it now consists of a number of thriving families. The formal designation which they give themselves is the United Society of Believers in Christ's Second Appearing. That of Shakers was given them in ridicule by unbelievers, but is nevertheless passively accepted by them. The founders were a number of obscure Quakers; and the Shakers still agree with the Friends in their rejection of the civil and ecclesiastical authority and military service, in their objections to taking oaths, their neglect of the common courtesies of society, their rejection of the sacraments, and their belief in the immediate revelations of the Holy Ghost (gifts). To these principles they add, according to Hepworth Dixon, who has in his *New America* (London and Leipzig, 1867) given one of the best recent accounts of the Shakers, the following beliefs: that the church of the future is an American church; that the old law is abolished, the new dispensation begun; intercourse between heaven and earth restored; that God is king and governor; that the sin of Adam is atoned, and man made free of all errors except his own; that every human being will be saved; that the earth is heaven, now soiled and stained, but ready to be brightened by love and labour into its primeval state. But these beliefs, according to the writer quoted, are not peculiar to them, but are shared more or less by every new American church. With the belief in the immediate revelations of the Holy Ghost is coupled that in angels and spirits, not as beings existing beyond the reach of human companionship, but as maintaining a regular intercourse with the saints, who profess to see them as clearly and talk with them as familiarly as with other human beings. At death the Shakers believe that they merely throw off a garment, changing the form of their existence, but no more. In their new existence, clad in the robes of light, they are invisible to the unpurified eyes of the world, but visible to those that have been purified and exalted by the gifts of grace. They expect no resurrection of the body. When the spirit throws it off it has done with it, and the dust that formed it is allowed to mingle with the dust of the earth as quickly as may be.

At first the motions from which they derive their name were of the most violent, wild, and irregular nature—leaping, shouting, clapping their hands, &c.; but at present they move in a regular, uniform dance to the singing of a hymn, and march round the hall of worship, clapping their hands in regular time. There were in 1890 fifteen Shaker societies distributed over the states of New York, Massachusetts, New Hampshire, Maine, Connecticut, Ohio, and Kentucky, and possessing church property valued at £7860. Their total membership was only 1728; when at its greatest it was only 4869, and it now appears to be steadily declining; but the Shakers are said to exercise an influence far above that which might be expected from their numbers. The societies are divided into smaller communities called families, each of which has its own male and female head. Celibacy is enjoined upon all, and married persons on entering the community must live together as brother and sister. In each society all property is held in common, and all bind themselves to take part in the family business—the men either as farmers, builders, gardeners, smiths, painters, or as followers of some other handicraft; and the women in some household occupation, or in the work of education.

The Shaker communities are distinguished for their industry, frugality, honesty, and good morals. Their villages are surrounded by an air of brightness and sweetness, and fill one with the sense of complete separation from the world. Their houses are models of cleanliness, comfort, and especially of good and skilful ventilation. Good food and sweet air, they say, are their only medicines; and very efficient medicines they seem to be, for the communities own no doctors, and are said to be free, or almost quite free, from the ailments that afflict most human beings, headaches, fevers, colds, &c. 'We have only had one case of fever in thirty-six years,' said the female head of one of the families in the community visited by Mr. Dixon, that of Mount Lebanon, in the state of New York; 'and we are very much ashamed of ourselves for having had it; it was wholly our fault.' The food they use is almost entirely the produce of the earth. They have three meals a day—one at six in the morning, one at noon, and one at six in the evening. In each sex the dresses are of a uniform cut, but they are not restricted to any particular colour. Since celibacy and chastity are laws of the sect, it is necessary that recruits should be gathered from outside their circle; yet they seldom make any attempt to attract converts by missionary work. One of their leading members, Elder Frederick (Frederick W. Evans), visited England in 1871, and lectured in London, and by this means a considerable number of new adherents were gained. But this is a step which they rarely take. As a rule they allow new members to come uninvited, of their own free-will, as they allow those who have joined to depart when they please. Persons are also permitted to settle for a time in the midst of their communities without seeking admission to full membership, and after trying the Shaker mode of life and seeing how they like it, may withdraw again if they don't like it, or may become full members if they do. Such members are called probationers, in contradistinction to the covenanters or full members, and are allowed to retain their private property as long as they remain at that stage. The periods of religious revival are said to be the occasions on which the most considerable accessions are made to the Shaker communities, and each of their eighteen societies or settlements is said to be the memorial of one such awakening in America.

The sect of Shakers was first introduced into America by Ann Lee, who, about 1770, became their leader. She was born at Manchester in 1736, and was the daughter of a blacksmith of Manchester, where she also at an early age became the wife of a blacksmith. She became in 1758 the convert of one Jane Wardlaw, a member of the Society of Friends at Bolton, in Lancashire, who preached in the market-place to the ignorant and brutal inhabitants of that town, exhorting them to repent of their sins, and declaring that the end of all things was at hand, that Christ was about to reign, and that his second appearance would be in a woman's form. After her conversion Ann Lee also began to preach, but was ultimately arrested as a nuisance, and sent to the Old Bailey prison in Manchester as a disturber of the public peace. After her release she told her hearers that while she was in prison a light had shone upon her, and the Lord Jesus had stood before her, and become one with her in form and spirit. Those who believed in her now began to look upon her and not upon Jane Wardlaw as their head. They gave her the title of 'Mother Ann,' while she styled herself 'Ann the Word.' She attempted to found a church in her native town, but was so much exposed to ridicule and annoyance that in 1774 she went out to America with seven followers, and formed the first settlement at Water Vliet, near Albany, where she

died in 1784. Before her death two new communities had been formed, one at Hancock and the other on Mount Lebanon. The leadership of the sect was now divided between two members, Joseph Meacham and Lucy Wright, to whom Ann Lee had herself committed the visible keys of her kingdom. To the former the Shakers owe their organization. After his death in 1796 Lucy was left as the sole leader, with the same title that had been borne by Ann, but as Lucy named as her successor not a mother but an elderess, the former title was given up as too august for any other female saint. There is a male as well as a female leader, and he bears the title of elder. See Hepworth Dixon's work referred to, and also Nordhoff's *Communitic Societies of the United States*.

SHAKSPERE, WILLIAM, the greatest dramatic poet that the world has yet produced, was born in 1564 at Stratford-upon-Avon, a market town in Warwickshire. The spelling of his name that we have adopted is that which appears in certain autograph signatures of the poet, but 'Shakspeare' has also autograph authority. The form 'Shakespeare' is again fully justified by its appearance on the title-page of *Venus and Adonis*, and that of *Lucrece*, the publication of which their author may have superintended. 'Shakespeare' is also the form of the name which has the sanction of the First Folio edition of his dramatic works (1623). The precise date of his birth is a matter of uncertainty. It is known (from the parish registers of his birthplace) that he was baptized on the 26th of April, and Malone, having regard to the intervals that usually elapsed at that time between birth and baptism, fixed on the 23rd of April (which also happens to be the day of his death and the day sacred to England's patron saint), as not unlikely to have been his birthday, and for that reason, for want of a better, that day is generally accepted as the true one. Allowing for the change from the Old to the New Style, our May 3rd corresponds to the old April 23rd. The father of William Shakspeare was John Shakspeare, who at the time of the poet's birth held a highly-respectable position among the citizens of Stratford, where he had been settled since 1551; and his mother was Mary Arden, daughter of a well-to-do farmer, Robert Arden of Wilmecote. The traditions and other sources of information about the occupation of Shakspeare's father differ. He is described as a butcher, a wool-stapler, and a glover, and it is not impossible that he may have been all of these simultaneously or at different times, or that, if he could not properly be called any one of them, the nature of his occupations was such as to make it easy to understand how the various traditions sprung up. There seems to be evidence that even before his marriage he was a landed proprietor and cultivator of his own land, and as such his employments would be more miscellaneous than they would be now, and would very likely include occasionally not only that of dealer in wool, but those of butcher and glover, which latter appears in those days to have been identical with that of fellmonger, and therefore to have consisted in preparing skins for the use of the leather-dresser. But if he was not a landed proprietor before his marriage, it is certain that he was after that event, for he got with his wife the estate of Asbies, some 50 acres in extent. William Shakspeare was the third child of his parents. The two older than he were daughters, and both died in infancy. After him were born three sons and two daughters, of whom one, Anne, died in 1579 at eight years of age. For ten or twelve years after Shakspeare's birth his father continued to be in easy circumstances. At Michaelmas, 1568, he became the high bailiff or chief magistrate of Stratford, and

for many years afterwards he held the position of alderman, as he had done for three years before. Till the completion of his tenth year at least, therefore, it is natural to suppose that William Shakspeare would get the best education that Stratford could afford. No doubt he would attend the free grammar-school of the town, and there is sufficient evidence in his works that the education he received there must have been of a satisfactory character so far as it went. As everybody knows, Ben Jonson afterwards said of him that he knew 'small Latin and less Greek'; but it must be remembered that Ben Jonson was an accomplished classical scholar, and that even a considerable knowledge of the ancient languages would seem little to him, so that his allowing that Shakspeare knew even a little Latin is the very reverse of being an argument to show that his education had been neglected, as has often been represented. It is not, however, probable that Shakspeare continued long at school. There seems to be no doubt that about the period of his life mentioned his father fell into embarrassments, so that he may not have been able to afford those little expenses that would be necessary even in keeping his son at a free school, or may, as one tradition asserts, have wanted his assistance at home. But even if this was not the case there would have been no necessity for a boy of Shakspeare's capacity continuing to attend the Stratford school for many years. By the end of his twelfth year he had probably mastered all the learning that was to be got there. The traditional accounts of the young Shakspeare's occupations after leaving school are as various as we have seen those of his father's business to be. Some say that he was apprenticed to a butcher, some that he was a school-master, some a lawyer's clerk. Possibly he had no fixed mode of supporting himself, but changed from one employment to another (none of them very lucrative) as circumstances or inclination suggested. There can be little doubt that it was in the ordinary vocations, and in the occupations of the leisure hours of these years following his leaving school, that Shakspeare acquired a large part of his vast stores of general knowledge, and in his walks amidst the beautiful scenery around Stratford made those minute and accurate observations of nature evidences of which are to be found in all his works. The first well-authenticated fact in Shakspeare's life that we come across after his baptism is his marriage. It had long been believed, on the authority of tradition, that Shakspeare had married very young, and this fact was established in 1836 by the discovery of his marriage-bond, which fixes no doubt within a few days the date of his marriage. The date of the bond is the 28th of November, 1582, when Shakspeare was little more than eighteen and a half years old. The woman he married was named Anne Hathaway, and was the daughter, according to tradition, of a substantial yeoman of the hamlet of Shottery, in the parish of Old Stratford. From her tombstone we learn that she was eight years older than Shakspeare. The marriage did not take place at Stratford, and it has never been ascertained where it did take place, but it is in the highest degree likely that the ceremony was performed within a very short interval after the date of the bond. On the 26th of May, 1583, Shakspeare's eldest child, a daughter named Susanna, was baptized. In the beginning of 1585 Shakspeare's wife gave birth to other two children, and these three were the only ones she bore him. The two born together were a son and a daughter, and were baptized in the month of February, receiving the names of Hamnet and Judith. Hamnet lived only to the age of eleven; but both daughters survived their father.

Down to the date we have now reached, the spring of 1585, Shakspeare, beyond all question, resided in Stratford, and it cannot have been long after that date—according to the received opinion it was in the year 1586—that he removed to London. The reasons that may have urged him to this step are easy to conjecture. He would no doubt find it difficult in Stratford to support his wife and family, and London would be the first place to suggest itself to him as likely to offer him scope for employing his talents to the best advantage in making a living. It is not wonderful either that he should turn his thoughts to the stage. Stratford was frequently visited by theatrical companies from London, and on occasion of these visits it would have been strange if Shakspeare had not made the acquaintance of some of the actors, and had his thoughts directed to the metropolis and the theatre. There is a well-known story which professes to give the occasion of his actual removal to London. It is said that he had been caught killing deer in a park belonging to Sir Thomas Lucy of Charlecote, near Stratford, and that being punished for it he had revenged himself by writing a stinging satire on the knight, and being menaced with further punishment made his escape to London. Whatever truth there may be in this Stratford tradition (and some biographers, in the excess of their jealousy for the stainlessness of Shakspeare's honour, have shown themselves needlessly anxious to discredit it), no one can believe that we are indebted to any such mere accident as this for the direction which Shakspeare's active life took. We may well suppose that Shakspeare would have gone to London about the time he did whether or not there was the special reason that made it advisable for him to quit Stratford.

What Shakspeare did to gain a living immediately after coming up to London is not known, but there is every likelihood that he very soon became engaged as an actor in one of the theatres. It is uncertain into which of the six licensed companies of adult actors he was at first admitted; perhaps it was into that under the patronage of Leicester, which after his death received the patronage of Lord Strange, and subsequently became the Lord Chamberlain's company. The London theatres, when Shakspeare began to act, were two—The Theatre, in Shore-ditch; and The Curtain, in Moorfields; it was probably for the former of these that the young Stratford aspirant was engaged. Wherever he may have acted, we have the authority of Aubrey, who was born ten years after Shakspeare's death, and who is the earliest collector of traditions concerning Shakspeare whose gossip has come down to us, for believing that 'he did act exceedingly well'. How long acting continued to be Shakspeare's sole profession we have no means of knowing, but it is in the highest degree probable that very soon after coming up to London he began that work of adaptation by which he is known to have begun his literary career. To improve and alter older plays not up to the standard that was required at the time of Shakspeare's arrival in London was a common practice even among the best dramatists of the day, and Shakspeare's abilities would speedily mark him out as eminently fitted for this kind of work; and it is not improbable that some of the doubtful plays attributed to Shakspeare may be such old or inferior plays that have received one or two touches from Shakspeare's hand. When the alterations in plays originally composed by other writers became very extensive, the work of adaptation would become in reality a work of creation; and this is exactly what we have examples of in a few of Shakspeare's early works, which are known to have been founded on older plays.

Some biographers throw back the production of Shakspeare's earliest original play as far as the year 1589; others think that he was nothing more than an adapter till 1593. Before the latter date he had certainly risen into notice; so much we can gather from contemporary allusions. The most interesting of these allusions, if only we could feel assured that the reference is to him, is one contained in Spenser's *Tears of the Muses*, which was published in 1591. In the section devoted to Thalia, Spenser, bewailing the decline of comedy, specially laments the silence of

'The man whom Nature self had made  
To mock herself, and truth to imitate,  
With kindly counter under mimic shade';

and in the next line he speaks of this man 'as our pleasant Willy', referring at the same time to Willy's death, which, if spoken of Shakspeare, must mean some temporary withdrawal from his work as a dramatist. But the probability is that Spenser here refers to some other actor or dramatic poet—possibly to the comic actor Tarlton, who was at this date actually dead. A reference in Spenser's 'Colin Clout's come home again' to Aetion, the young eaglet (*derós*), may possibly be to Shakspeare:

'And there, though last, not least is Aetion;  
A gentler shepherd may no where be found,  
Whose muse, full of high thought's invention,  
Doth, like himself, heroically sound'.

The name Shakspeare 'sounds heroically'; but the allusion may be to Drayton, who had assumed as a poet the heroic name of Roland. A more unmistakable allusion to Shakspeare is to be found in Robert Greene's *Groatsworth of Witte*, published in 1592. The author there writes: 'There is an upstart crowe, beautified with our feathers, that with his tygres heart, wrapt in a player's hyde, supposes he is as well able to bombaste out a blanke verse as the best of you; and being an absolute Johannes Factotum is, in his own conceyt, the only Shakescene in a countrey'. There is here an obvious play upon Shakspeare's name and a reference to his profession of an actor, and apparently also to that of adapter, for although a different interpretation may be given to the first part of the allusion (which some suppose to refer merely to his acting), the expression 'Johannes Factotum' seems clearly to imply that the person of whom it was used was quite ready to undertake other duties, those of a playwright as well as those of an actor. This allusion to Shakspeare is worthy of comment for another reason. Its spirit is in singular contrast with that of the other allusions to him that have come down to us from his contemporaries. The language which they use respecting him is such as to justify De Quincey's remark, 'that the term gentle was almost as generally, and by prospective right, associated with his name as the affix of venerable with Bede, or judicious with Hooker'. Fellow-actors, fellow-poets, and those who knew him in other ways, agree in expressing not only admiration of Shakspeare's genius, but their respect and love for the man. Ben Jonson said, 'I loved the man, and do honour his memory, on this side idolatry, as much as any. He was indeed honest, and of an open and free nature.' It is satisfactory to know that Greene's editor Henry Chettle offered an amends for Greene's attack; 'myself have seen his demeanour', wrote Chettle in this apology prefixed to his *Kind Hartes Dreame*, 'no less civil than he excellent in the qualitie [the actor's profession] he professes; besides divers of worship have reported his uprightness of dealing, which argues his honesty, and his facetious grace in writing that approves his wit'.

In 1593 Shakspeare published his *Venus and Adonis*, with a dedication to the Earl of Southampton, in which he refers to his poem as 'the first heir of his invention'. Whether he means by this that *Venus and Adonis* was absolutely his first original production, or merely his first poem, his plays, which were published only on the stage, being left out of account, we cannot tell; but if the former is the meaning, that is no reason for concluding that he had written no original play before the date of publication of that poem. The poem may have been really his first essay in literature, written long before it was published. There is, indeed, no great improbability involved in the suggestion that it was in existence in some form or other before he left Stratford. In 1594 Shakspeare published his other poem, *The Rape of Lucrece*, which is also dedicated to the Earl of Southampton, and in a tone that indicates that since the publication of the last poem a greater intimacy had grown up between the poet and the peer. These two poems are the only productions of Shakspeare that were published probably under his own superintendence.

If 1593 was indeed the date at which Shakspeare commenced original dramatic composition, his activity between that year and 1598 must have been great, for we know that by the year 1598 at least eleven of his plays (twelve, if *Titus Andronicus* is his) had been already brought forth. The source of our knowledge of this fact is a passage in Meres's *Palladis Tamia* or *Wit's Treasury*, which was published in that year, and in which the author, glorifying the productions of Shakspeare, gives the names of so many of his plays as proofs of his excellence in comedy and tragedy, and there is no reason to assume for certain that this list is complete. Those named by him are: *The Two Gentlemen of Verona*, *Comedy of Errors*, *Love's Labour's Lost*, *Love's Labour's Won* (supposed to be *All's Well that Ends Well*), *Midsummer-Night's Dream*, *Merchant of Venice*, *Richard II.*, *Richard III.*, *Henry IV.*, *King John*, *Titus Andronicus*, and *Romeo and Juliet*. Meres also mentions Shakspeare's 'sugred sonnets', as circulating among his private friends.

It is clear, then, that long before 1598 Shakspeare had begun to derive an income from writing for the stage, in addition to what he derived from acting; and we have other evidence to show that at this time his worldly circumstances must have been good. It was long believed, on the authority of a document alleged by Collier to be of his discovery, that as early as 1589 Shakspeare had another source of income through being a shareholder in the Blackfriars Theatre; but this document has since been proved to be a forgery, and the information it contains to be incorrect. An indication, however, of Shakspeare's advance in fortune may be found in the fact that in 1596 his father, who had much declined in prosperity, applied to the College of Heralds for a coat-of-arms, which, after considerable delay, was granted three years later. The father's interest in this matter was probably on behalf of the son. It was not till after the building of the Globe Theatre on the Bankside (1599) that Shakspeare was made a partner in the profits of the house. The Globe Theatre was built by Cuthbert and Richard Burbage—the latter being the eminent actor who took the leading parts in Shakspeare's plays. The Burbages leased for twenty-one years the receipts of the theatre to certain 'deserving men', of whom Shakspeare was one. He had also a certain interest, though a smaller one, in the Blackfriars Theatre. In 1608 James I. granted a patent to the proprietors of the Globe and Blackfriars theatres, who thence became known as the king's players.

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The result of all this is, that before the end of the century, or before the completion of Shakspeare's thirty-sixth year, Shakspeare was at the same time actor, dramatist, and shareholder in a theatre; and we know that about this time (in May, 1597) he was able to purchase the best house in Stratford, known as New Place, and that before this the fallen fortunes of his father had been re-established, probably through his assistance. In 1602 Shakspeare bought 107 acres of land adjacent to his house, besides another property; and in 1605 he made his largest purchase, giving £440 (roughly estimated as equivalent to about £2500 in our day) for the unexpired term of a lease of certain tithes. Aubrey mentions the tradition that he was in the habit of visiting his native town once a year, and it has been naturally conjectured that after the acquisition of his property there his visits would be longer, if not more frequent. It has been disputed whether Shakspeare was ever out of England. There is good evidence to show that the company with which he was connected made a tour in Scotland while the connection lasted, and it has reasonably been conjectured that he was of the number on that occasion. Not so much can be said in favour of another conjecture, that he was once as far as Italy. During the last years of his life it is supposed that Shakspeare lived mainly at Stratford, occasionally sending a play up to London, and occasionally going there himself. He died at Stratford on the 23rd of April, 1616.

Shakspeare's father had died before him, in 1601, and his mother in 1608. His wife survived till August, 1623. His eldest daughter, Susanna (to whom he left all his real estate, his wife having a sufficient provision in the dower to which she was entitled by law), had in 1607 married a physician of Stratford, Dr. Hall. The only issue of this marriage, a daughter named Elizabeth, born in 1608, married first a Stratford gentleman, Thomas Nash, and afterwards Sir John Barnard, but left no children by either marriage. Lady Barnard died in February, 1670. His younger daughter, Judith, on the 10th of February, 1616, married a certain Thomas Quiney of Stratford, subsequently a vintner, by whom she had three sons, all of whom died, however, without issue. There are thus no direct descendants of Shakspeare.

Such is the gist of what the diligence of biographical inquirers, extended over more than two centuries, has been able to discover about Shakspeare. The documentary information regarding him is scanty. Of his own private papers not a scrap has come down to us. It is not unlikely that a good deal belonging to him perished in 1613, when the Globe Theatre was burned. Aubrey has already been mentioned as our oldest authority for traditions relating to Shakspeare; but Betterton, the actor, was the first to make serious efforts to rescue the facts of his life from oblivion, and the results of his investigations he communicated to Rowe, who wrote the first account of his life. The principal works that have been specially devoted to this subject are those of Drake (two vols., 1817), Skottowe (two vols., 1824), Knight (1842), J. O. Halliwell-Phillips (1874-1889), Sidney Lee (1898). The absence of claims made by himself to the authorship of the plays has induced many at various times to question the attribution of them to William Shakspeare, the actor. Miss Delia Bacon, an American lady, in 1856 advanced the theory that their authorship should really be assigned to Lord Bacon; and other writers, including Mrs. Henry Pott, have accumulated many curious coincidences in support of this view. Chief among them, a Mr. Ignatius Donnelly, an ex-member of the

United States Congress, claimed in 1887 to have discovered a cypher in the plays themselves, by which it was possible to extract from them a distinct assertion that Bacon was the author, together with an account of his relations with Shakspeare, and other facts of historic importance. The cypher, however, like another more recently put forward, failed to stand the test of critical examination, and the theory that Bacon was the author has obtained support only with persons of eccentric speculation or imperfect scholarship.

Thirty-seven dramatic pieces are now usually published in the editions of Shakspeare's collected works. These are: *The Tempest*, *The Two Gentlemen of Verona*, *The Merry Wives of Windsor*, *Measure for Measure*, *The Comedy of Errors*, *Much Ado about Nothing*, *Love's Labour's Lost*, *A Midsummer-Night's Dream*, *The Merchant of Venice*, *As You Like It*, *The Taming of the Shrew*, *All's Well That Ends Well*, *Twelfth Night*, *The Winter's Tale*, *The Life and Death of King John*, *The Tragedy of King Richard II.*, *The First Part of King Henry IV.*, *The Second Part of King Henry IV.*, *The Life of King Henry V.*, *The First, Second, and Third Parts of King Henry VI.*, *The Tragedy of King Richard III.*, *The Famous History of the Life of King Henry VIII.*, *Troilus and Cressida*, *Coriolanus*, *Titus Andronicus*, *Romeo and Juliet*, *Timon of Athens*, *Julius Caesar*, *Macbeth*, *Hamlet*, *King Lear*, *Othello*, *Antony and Cleopatra*, *Cymbeline*, *Pericles*. The first thirty-six of these plays appeared in the first edition of Shakspeare's collected works in 1623, the last appeared for the first time along with six others which have not been accepted as genuine in the 1664 issue of the third folio, which had appeared without these seven added plays in the previous year. Of the thirty-seven mentioned thirty are usually admitted as entirely or almost entirely the genuine productions of Shakspeare, the remaining seven, *Titus Andronicus*, the three parts of *Henry VI.*, *Timon of Athens*, *Pericles*, and *King Henry VIII.*, are in a greater or less degree suspected. Considerable suspicion attaches to *Titus Andronicus* and *The First Part of Henry VI.*, which are indeed rejected by many Shaksperian critics as altogether spurious. The opinion of critics is more favourable to the Shaksperian authorship of the second and third parts of *King Henry VI.*, although many think that they are among those that were merely re-handled by Shakspeare, having originally proceeded from some other hand. In the case of the other three it appears to be generally agreed that some parts are certainly Shakspeare's, but that more or less of each had some other author. Parts of *Troilus and Cressida* are also believed not to be Shakspeare's, and one or two other plays (as *The Taming of the Shrew*) are known to have been founded on older ones. The only other play which has been partly ascribed to Shakspeare by a respectable weight of authority is *The Two Noble Kinsmen*, usually published among Beaumont and Fletcher's works. This play was first published in 1634, and its title-page stated that it was the work of 'Mr. John Fletcher and Mr. William Shakspeare, Gent.'; and there is reason to believe that the information contained in that title-page is correct. (See the *Westminster Review* for April, 1847.) The other plays that have at different times and by different persons been attributed to Shakspeare have little if anything to support their claims. Yet we may as well mention their titles. The six already referred to as appearing along with *Pericles* in the third edition of Shakspeare's works over and above those which appeared in the first two are: *The Tragedy of Loocrine*, *The First Part of the*

*Life of Sir John Oldcastle*, *The Chronicle History of Thomas Lord Cromwell*, *The London Prodigal*, *The Puritan*, and *A Yorkshire Tragedy*. It cannot be denied that the last of these is a work of remarkable power, and some critics are not unwilling to suppose that it came from Shakspeare's hand. In later times there have been attributed to him *The Reign of King Edward III.* (for parts of which there are still some advocates) and *The Tragedy of Arden of Feversham*; and finally, some German critics have thrust on Shakspeare's shoulders *The Comedy of George-a-Green*, *The Comedy of Mucedorus*, *The Birth of Merlin*, and the *Merry Devil of Edmonton*. This list does not include the fabricated play of *Vortigern*, the principal of the celebrated Shakspeare forgeries of William Henry Ireland.

Shaksperian scholarship has not yet been able to determine the precise dates of his plays, or even to fix in any but a rough manner the order of their production. In the following list, in which we give various particulars regarding the several plays, the arrangement is based on the facts indicated by Charles Knight, with some additions and corrections, as showing the latest date that can be assigned to each of them. In many cases there is no doubt that the date of their production was much earlier. After each play we have mentioned the source or sources from which Shakspeare derived the materials or received suggestions for its construction so far as they are known. With regard to Shakspeare's use of his authorities it ought to be mentioned that the closeness with which he follows them depends altogether on their nature. Sometimes they merely furnished the faintest hint of a plot or character, but when they served his purpose as they stood he used them freely without the slightest scruple, borrowing at times their very language, with only such slight changes as sufficed to convert into poetry what in the original was but prose. 1. *Henry VI. Part I.*, alluded to by Nash in 1592. This play was first printed in the folio edition of Shakspeare's collected dramatic works in 1623. It is founded upon Holinshed's *Chronicle*, as all his English historical plays are more or less. 2. *Henry VI. Part II.*, printed in 1594 under the title of *The First Part of the Contention between the Two Famous Houses of York and Lancaster*. It was first printed in its present form in 1623. 3. *Henry VI. Part III.*, printed in 1595 under the title of *The True Tragedy of Richard, Duke of York*. Also first printed in its present form in 1623. 4. *Richard II.*, printed in 1597. 5. *Richard III.*—perhaps earlier in date of composition than *Richard II.*—printed in 1597, founded not only on Holinshed but also on Sir Thomas More's *History of the Pitiful Life and Unfortunate Death of King Edward V. and the Duke of York, his Brother*. 6. *Romeo and Juliet*, printed in 1597, in its present form in 1599; founded on a poetical version by Arthur Brooke (1562) and a prose version by Painter (*Palace of Pleasure*, 1566-69) of an Italian tale by Bandello. 7. *Love's Labour's Lost*, printed in 1598, but probably one of the very earliest of the plays. 8. *Henry IV. Part I.*, printed in 1598; founded on Holinshed and an older drama. 9. *Merchant of Venice*, mentioned by Meres in 1598; printed in 1600; founded on a tale contained in an Italian collection called *Il Pecorone* by Giovanni Fiorentino, the incident of the caskets on a story in the *Gesta Romanorum*. 10. *Midsummer-Night's Dream*, mentioned by Meres in 1598; printed in 1600; partly founded upon Chaucer's *Knight's Tale* and the popular notions of Robin Goodfellow. 11. *All's Well that Ends Well*, supposed to be the *Love's Labour's Wom* of

Meres's list (1598). Craik, however, has in the *Prolegomena* to his *English of Shakspeare* given plausible reasons for believing *The Taming of the Shrew* to be the play designated as *Love's Labour Won*. All's Well that Ends Well is founded on a tale by Boccaccio in Painter's Palace of Pleasure. It was first printed in 1623. 12. *Two Gentlemen of Verona*, mentioned by Meres; first printed in 1623. This play, which is probably of a very early date, is often said to be partially founded on the story of Felismena in Montemayor's pastoral romance, *Diana* (Spanish); but as Yonge's translation of this work did not appear till 1598, long before which date *The Two Gentlemen of Verona* was probably produced, this is at least a doubtful supposition. 13. *Comedy of Errors*, mentioned by Meres, but of very early date; first printed in 1623; founded on the *Menæchmi* of Plautus. 14. *King John*, mentioned by Meres; first printed in 1623; founded on an older play by an unknown author. 15. *Titus Andronicus*, mentioned by Meres; printed in 1600; doubtless one of Shakspeare's earliest plays, if of his authorship. 16. *Henry IV. Part II.*, printed in 1600; founded on Holinshed and an older drama. 17. *Henry V.*, printed in 1600; in its present form in 1623; founded on Holinshed and an older drama. 18. *Much Ado about Nothing*, printed in 1600; partly founded on a tale by Bandello. 19. *As You Like It*, entered at Stationers' Hall in 1600; founded on a tale by Thomas Lodge. 20. *Twelfth Night*, or, *What You Will*, acted in the Middle Temple Hall in 1602; first printed in 1623; founded on a tale by Bandello given in Rich's Farewell to Militarie Profession (1581). 21. *Othello* (probably 1604), printed in 1622; founded on an Italian tale by Giraldi Cinthio, of which, however, there is not known to have been any English translation in Shakspeare's time. 22. *Merry Wives of Windsor*, printed in an imperfect form in 1602; first printed in its present form in 1623. There is a well-known tradition regarding this play, that it was composed at the command of Queen Elizabeth, who was so delighted with the character of Falstaff that she desired to have it continued in another play in which he should be represented as in love. The adventures of Falstaff are said to bear some resemblance to those in *The Lovers of Pisa*, a tale contained in Tarleton's *News out of Purgatorie*, published about 1590. 23. *Hamlet*, printed in a version considerably different from the present one in 1603; the present version printed in 1604. The story on which the play is founded is contained in the Danish historian Saxo Grammaticus, and appeared before Shakspeare's time in a French version by Belleforest. 24. *Measure for Measure*, acted at Whitehall in 1604; first printed in 1623; founded on an older drama by Whetstone entitled *Promus and Cassandra* (1578). 25. *King Lear*, acted at Whitehall in December 1606; printed in 1608; founded on Holinshed, *The Mirror of Magistrates* (1587), and Sir Philip Sidney's *Arcadia* (1590). 26. *Taming of the Shrew*; founded on an older drama by an unknown author entitled *Taming of a Shrew*, which was printed in 1594. 27. *Troilus and Cressida*, printed in 1609, but probably written in 1603; founded on Chaucer's *Troilus and Cressida*, on Caxton's *Histories of Troye*, Lydgate's *Troye Book*, and Chapman's *Homer* (1596-1600). 28. *Pericles, Prince of Tyre*, printed in 1609. 29. *The Tempest*; first printed in the folio edition of 1623; partly founded on or suggested by incidents recorded in various books of travel. 30. *Winter's Tale*; first printed in 1623; founded on *The Pleasant and Delightful History of Dorastus and Fawnia* by Robert Greene (1588). 31. *Henry VIII.*, acted as a new play

when the Globe Theatre was burned in 1618; first printed in 1623. It is founded on Holinshed, Cavendish, and Fox. There are still six plays, for which Mr. Knight was able to give no certain data to determine the latest possible date of production. They were all published for the first time in 1623, and it is certain that they all belong to Shakspeare's maturer period. They are—32. *Macbeth*, founded on Holinshed and Reynalde Scott's *Discoverie of Witchcraft* (1584). There appear to be reasons for believing that this play was written between 1603 and 1610. 33. *Julius Cæsar*, founded on North's *Plutarch*; it was probably written in 1601. 34. *Antony and Cleopatra*, also founded on North's *Plutarch*. It is by some conjecturally assigned to 1607. 35. *Coriolanus*, also founded on North's *Plutarch*, supposed to belong to about the same date as the last-mentioned play; probably 1608. 36. *Cymbeline*, founded on Holinshed and a tale of Boccaccio—the ninth of the second day. This play is said to have been written in 1609. 37. *Timon of Athens*. Whatever share Shakspeare had in this play belongs to his ripest period; its date is perhaps 1607-8.

Summarizing the results of recent scholarship, we may say that Shakspeare began his dramatic career with such crude work as is contained in *Titus Andronicus* and 1 *Henry VI.* The series of histories was continued from 1591 to 1595 with 2 and 3 *Henry VI.*, *Richard III.*, *Richard II.*, *King John*. At the same time a group of early comedies—*Love's Labour's Lost*, *Comedy of Errors*, *Two Gentlemen of Verona*, and *Midsummer-Night's Dream*—was produced. A tragedy and a comedy—*Romeo and Juliet* and *The Merchant of Venice*—followed. The historical series was carried on in 1 and 2 *Henry IV.* and *Henry V.*, and with these the comedy of the *Merry Wives* is closely connected. Perhaps the *Taming of the Shrew* belongs to the same period as the *Merry Wives*. A group of joyous comedies succeeded—*Much Ado*, *As You Like It*, and *Twelfth Night*. The great tragedies open with *Julius Cæsar* and *Hamlet*. The comedies now grow earnest and almost stern or full of irony in *All's Well*, *Measure for Measure*, and *Troilus and Cressida*. Then tragedy follows tragedy—*Othello*, *Lear*, *Macbeth*, *Antony and Cleopatra*, *Coriolanus*, *Timon*. Finally, plays which are of the nature of grave and sweet romances appear—*Pericles*, *Cymbeline*, *The Tempest*, *Winter's Tale*. Shakspeare's dramatic career closes with fragments—a contribution to *Henry VIII.* and possibly a contribution to *The Two Noble Kinsmen*.

The non-dramatic pieces of which Shakspeare was the author, and the chief of which have been already mentioned, are *Venus and Adonis*, published in 1593; *Lucrece* in 1594; a collection of poems, only a few of which are believed to be Shakspeare's, entitled *The Passionate Pilgrim*, and published in 1599; the *Phoenix* and the *Turtle*, a short poem, which appeared in a volume entitled *Love's Martyr* or *Rowlin's Compliment* by Robert Chester, 1600; and the *Sonnets and Lover's Complaint*, published in 1609, although, as we learn from the passage in Meres referred to in the notice of Shakspeare's life, a number of the sonnets must have existed and circulated privately as early as 1598. The sonnets have been the subject of much controversy, turning chiefly upon the questions of who the person or persons are to whom they are addressed and what is the amount of biographical information that may be obtained from them. On their first publication they bore a dedication from the publisher, who signs himself T. T. (Thomas Thorpe), to one W. H., who is styled, 'the onlie begetter of these insuing sonnets'; and it is a point of controversy who this W. H. is. Some think that

he is William Herbert, earl of Pembroke, and that he is called the 'onlie begetter' of the sonnets, because it is to him that a large part of them are addressed; others suppose that he is Henry Wriothesley, earl of Southampton (the initials reversed); while Mr. Sidney Lee conjectures that he is an obscure publisher, William Hall, who, as he imagines, transferred the manuscript of the sonnets to Thorpe, and who might thus be styled their begetter. These, however, are mere conjectures, and the same must be said with regard to all the numberless other theories that have been started with reference to the same subject. The supposed identification of the woman to whom some of the later sonnets are addressed with Mary Fitton, a maid of honour to Queen Elizabeth, has ceased to possess the favour it once had with a few Shaksperian scholars. As to the biographical information that many have looked for in these poems little of that nature has as yet been gleaned, although some of the sonnets certainly derive a special interest from the fact that they make us more intimately acquainted with some features of Shakspeare's mind than we could hope to become from his plays. Among other sonnets, 29, 30, 66, 110, and 111 may be mentioned as peculiarly interesting on this account.

The first edition of Shakspeare's collected dramatic works was prepared by two friends and fellow-actors of Shakspeare—John Heminge and Henrie Condell, and was published in 1623, seven years after Shakspeare's death, with a dedication to the Earls of Pembroke and Montgomery, and an address to the reader, in which the editors condemn all previous editions (namely, of the separate plays) as surreptitious, and as 'maimed and deformed by the frauds and stealths of injurious impostors', and declare that these are now offered 'cured and perfect of their limbs, and all the rest [namely, all those which had not previously been published] absolute in their numbers', as the author conceived them. The address also mentions the fact, interesting with reference to Shakspeare's habits of composition, that scarce a line of the manuscripts was blotted. This edition was in folio, and as three other editions were published in the same form it is usually known as the first folio. The editions of some of the separate plays that have been mentioned as published during Shakspeare's lifetime were all in quarto, and are hence known as the quartos. The first folio contains thirty-six plays, namely, all those now generally published among Shakspeare's dramatic works, with the exception of *Pericles*. In spite of the opportunities which the editors say they had for issuing a trustworthy edition, the first folio of Shakspeare is a very faulty production, being full of typographical and other errors. There is little likelihood of its having received any considerable correction of the press from the nominal editors. That duty was no doubt left to the printers. Yet in the absence of Shakspeare's own manuscripts (all of which have been lost) this edition—with such help as can be obtained from the quartos—is necessarily the basis of all attempts at arriving at a correct text of Shakspeare's plays. The second folio was published in 1632, and in point of accuracy is even inferior to the first, but it contains some new readings (probably conjectural emendations), which have been adopted in all later impressions of Shakspeare's plays. The third folio was published in 1664, and the fourth in 1685. Neither of these editions is allowed to have any textual authority. The third edition, as we have already had occasion to mention, contains, besides those plays which appeared in the first two, the play of *Pericles* and six others not now admitted to be by Shakspeare. These four folios are all the editions

of Shakspeare's collected works that were put forth in the seventeenth century. The eighteenth-century editions are numerous. The principal are those of Rowe (1709-10; second edition, 1714); Pope (1723-25; second edition, 1728); Theobald (1733); Hanmer (1744-46); Pope and Warburton (1747); Johnson (1765; second edition, 1768); Capell (1767-68); Johnson and Steevens (1773); Malone (1790). The first American edition appeared at Philadelphia, 1795-96; it had the notes of Johnson. Rowe's was the first edition in which the text was to any extent critically examined. Theobald, a severe critic of Pope's work, was eminent in scholarly study and felicitous emendation. The preface and the explanatory notes give value to Johnson's edition, and the careful collation on which the text is founded gives great importance to Capell's. Steevens and Malone were the most laborious of all the Shaksperian commentators of the eighteenth century. In the nineteenth century, editions of Shakspeare have been multiplied with great rapidity. In the early part of the century the most important are perhaps Boydell's edition of Steevens's Shakspeare, in nine vols., with 100 engravings (1802), and the 'variorum' editions (that is, editions containing the notes of various critics and commentators) of 1803, 1813, and 1821, each in twenty-one vols., the first prepared for the press by Reed; the last by Boswell, the son of Johnson's celebrated biographer. Among more recent editions the most esteemed are those of Singer, ten vols., 1826 and 1856; Charles Knight (the Pictorial Edition, with notes, eight vols., 1838-43, frequently reprinted and reissued in various forms); Halliwell (four vols., 1851-53); Collier (eight vols., 1841-44; second edition, 1853); Hazlitt (with notes, four vols., 1851; 5th vol., containing doubtful plays, 1853); Dyce (second edition, nine vols., 1864-67—many textual notes); Grant White (Boston, twelve vols., 1857-63); Clark and Wright (the Cambridge Shakespeare, nine vols., 1863-66; second edition, 1887; very rich in its textual apparatus); Staunton (three vols., 1858-1860, with notes); Carruthers and Chambers (The Household Shakespeare, ten vols., 1861-63); Charles and Mary Cowden Clarke (four vols., 1864); Clarke and Wright (the Globe Edition, one vol., 1874); Keightley (six vols., 1864-65); and the Henry Irving Shakespeare (Blackie & Son), edited by Henry Irving and Frank A. Marshall, richly furnished with notes, introductions, &c., and beautifully illustrated (eight vols., 1888-90). The American editions of Rolfe, forty vols., 1871-96, and of Hudson, twenty vols., 1881, also contain much valuable work. To give an idea of the circulation of Shakspeare's works, we may state that about 1,000,000 copies of Dick's shilling edition were sold within some four years. Besides these editions, intended for general purchasers, we may also mention the sumptuous edition of J. O. Halliwell, printed between 1853 and 1865, in sixteen vols., of which only 150 copies were struck off. In 1871 there appeared at Philadelphia the first volume of a new variorum edition of Shakspeare's works, designed on a very comprehensive plan. Each play is exhaustively treated in a separate volume. The editor is Horace Howard Furness. In 1864-65 a fac-simile of the first folio was produced under the care of Howard Staunton by the process of photo-lithography. Booth's page-for-page reprint of the same folio (1864) is a work of almost flawless accuracy. Fac-similes have also been prepared by Ashbee of several of the early quartos, and a series executed under the general superintendence of Dr. F. J. Furnivall enable students to explore the original sources of Shakspeare's text. In 1852 the publication by J. Payne Collier of a volume entitled *Notes and Emendations to the*

Text of Shakespeare's Plays, the emendations in which were derived from manuscript corrections made in a copy of the second folio that had come into Mr. Collier's possession, gave rise to a remarkable controversy that was carried on for many years with great heat in England, America, and Germany. Mr. Collier expressed his belief that these manuscript corrections belonged to a very early date, perhaps almost as early as that of the folio itself, and argued that it was probable that the annotator had some good authority (such as stage performance) for making them. Although Collier was himself in all probability the manufacturer of the manuscript corrections, certain of these are of value, and have been adopted by subsequent editors of Shakespeare's plays. In 1853 Collier published in one volume an edition of Shakespeare's plays with the text regulated by the manuscript emendations in his second folio, as well as by other old copies of the plays.

The aids to the study of Shakespeare, other than critical and annotated editions of his works, are extremely numerous. Perhaps the best of the psychological studies of the dramatist in English are S. T. Coleridge's *Notes and Lectures upon Shakespeare* and some of the old *Poets and Dramatists* (1849), and Hazlitt's *Characters of Shakespeare's Plays* (1817). Dowden's *Shakespeare his Mind and Art*, Swinburne's *Study of Shakespeare*, and Boas's *Shakespeare and his Predecessors* are works of more recent date. The versification of Shakespeare has been excellently treated by Walker (1854). Valuable works on the English of Shakespeare are that of Craik, in which that subject is illustrated in a commentary on the play of *Julius Cæsar* (1857), and the *Shakespearean Grammar* of E. A. Abbott (1869; new edition, 1871). The first good Shakespearean glossary was that of Archdeacon Nares (1822; edition of Halliwell and Wright, 1859). In 1845 Mary Cowden Clarke published a complete concordance to the plays of Shakespeare, and in 1874 this was supplemented by a concordance to the poems, prepared by Mrs. Howard Furness. The *Concordance of Bartlett*, dealing with both plays and poems (1894), is the most complete and most convenient. In 1874 and 1875 there was published at London and Berlin a *Shakespeare Lexicon* (two vols., now in a new edition), by Dr. A. Schmidt, in which the occurrences of each word are classified according to the sense, so that the work serves both as a lexicon and concordance. J. Payne Collier shed great light on the sources from which Shakespeare most probably derived the materials from which he constructed, or the hints which suggested his plays, by the publication of his *Shakespeare's Library* (first in numbers, afterwards in two vols., 1843; second edition, with additions by W. C. Hazlitt, 1875). Between 1841 and 1853 a 'Shakespeare Society' published a number of works interesting on various grounds to Shakespearean students. In the latter year the society was dissolved, but a new one was formed through the efforts of Dr. Furnivall. It issued many valuable works, and paid special attention to the study of the verse of Shakespeare as an aid to determining the chronology of his plays. Dr. Ward's *History of English Dramatic Literature* (latest edition three vols., 1899) and various works of Mr. Fleay are valuable aids to the Shakespearean student.

Although some of Shakespeare's pieces were performed in Germany in more or less faithful versions in the early part of the seventeenth century, it was not till after the middle of the eighteenth that the Germans really became acquainted with Shakespeare. The credit of this belongs to Lessing, who in 1759 began to publish a series of essays on the works of the great dramatist. Wieland followed with a

translation of twenty-two of the plays (Zürich, 1762-66), and this translation was made the basis of that of Eschenburg (Zürich, 1775-82; new and revised edition, 1798-1806). But the translation which eclipsed all others, and which is almost universally regarded as a master-piece in its kind, is that begun by Aug. Wilh. von Schlegel (nine vols., seventeen plays, Berlin, 1797-1810), and continued by Ludwig Tieck, in conjunction with his daughter Agnes and Count Wolf von Baudissin (nine vols., Berlin, 1825-33). Since the appearance of that translation Shakespeare has been considered as belonging to German almost as much as to English literature, and there has been an honourable rivalry between England and Germany in the endeavour to interpret and illustrate his works. Two excellent German translations have subsequently appeared. The one was carried out by F. Bodenstedt in conjunction with F. Freiligrath, O. Gildemeister, P. Heyse, Hermann Kurz, A. Wilbrandt, &c., with the assistance of the celebrated Shakespearean critic Delius (4th ed., Leipzig, 1881, 4 vols.). The other translation, carried out by Dingelstedt, Simrock, W. Jordan, &c., appeared in 1867-68, 10 vols. A revision of the Schlegel and Tieck translation, under the direction of Ulrici, has also been recently issued. Germany has been very fruitful in æsthetic criticism of Shakespeare. To this department the principal contributions are Goethe's exposition of Hamlet in *Wilhelm Meister*; Ulrici's *Shakespeare's Dramatische Kunst* (Halle, 1839; second edition, Leipzig, 1847, translated 1846); Gervinus's *Shakespeare* (third edition, 1862; translated into English by F. E. Bunnett; new edition of the translation, 1875); and various sections of the æsthetic works of Friedrich Theodor Vischer. Among the other important Shakespearean works of German origin are Simrock's *Quellen des Shakespeare* (1872); Cohn's *Shakespeare in Germany in the Sixteenth and Seventeenth Centuries* (London and Berlin, 1865); Schmidt's *Shakespeare Lexicon*, already mentioned among the English works; and Delius's critical edition of the works of Shakespeare (Elberfeld, seven vols., 1854-61; 5th edition, 1882). On the 23rd of April, 1864, the 300th anniversary of the poet's birth, a Shakespeare society was founded in Germany for the encouragement and consolidation of Shakespearean studies. It was under its auspices that Ulrici's revision of the Schlegel and Tieck translation was commenced. The society has published annually its *Jahrbuch* (Year-book) containing studies by the most eminent German scholars.

Shakespeare was introduced to the knowledge of the French by Voltaire, who, during a visit to England, learned to admire his genius, although he utterly failed to comprehend his art. (See Jusserand's *Shakespeare in France*, 1899). The first French translation of his works was that of Letourneur, which appeared in twenty vols. between 1776 and 1782. A revised and corrected version of this translation was prepared by F. Guizot and A. Pichot (fifth edition, 1865). The most faithful of the French translations is that of François Victor Hugo into prose (18 vols., 1859-66). A translation of the complete dramatic works of Shakespeare into Italian was made by Carlo Rusconi (Padua, 1838; sixth edition, Florence, 1878-74). There are also translations into Danish, Dutch, Swedish, Bohemian, Polish, Hungarian, and Russian, and there are translations of one of the plays (*Merchant of Venice*) even into Tamil and Mahratti. In 1870 there appeared the first volume of a translation of Shakespeare's works into Spanish by Jaime Clark; but only ten plays were published. Among the most recent additions to Shakespearean criticism are William Shakespeare, a *Critical Study*, by the eminent Danish critic George Brandes (translated, 2 vols., 1898);

Professor Garlando's *Guglielmo Shakespeare, il Poeta e l'Uomo* (1900); and Mr. Mabie's *William Shakespeare, Poet, Dramatist, and Man*. A useful bibliography of Shakespeare will be found in the British Museum Catalogue of Printed Books, the Shakespeare portion of which is separately issued.

**SHAMANISM** is the name given to the primitive religion of the Mongolian race. Shamans, in Great Tartary and Mongolia, a part of China, Siberia, and Kamtschatka, are priests, who are at the same time physicians, sorcerers, and conjurers. The character of Shamanism has been greatly modified and its sway restricted by the spread of the doctrines of Confucius and Zoroaster, and of Buddhism and Christianity, with all of which it has blended to form systems which have more or less superseded the original worship. The primitive Shamanism recognized the existence of many gods, some created, some increate, existing in the form of heavenly bodies, or of animals, or of inanimate things, or arbitrarily formed by human hands. It also taught the existence of good and bad spirits. After death men continue to exist in a melancholy condition, influenced neither by good nor bad works. The religious service of the Shamans consists of sacrifices, prayers, &c., by which the worshippers hope to gain the favour of the good gods and avert the wrath of the bad.

**SHAMO, DESERT OF.** See **GOBI**.

**SHAMPOOING**, the name given in the East Indies to a process of bathing, in which the whole body is pressed and kneaded by the attendants. See **BATH**.

**SHAMROCK** (in the Gaelic, *seamrog*), probably, in the Irish and Gaelic languages, a generic term for trefoils. The name is commonly given to the heraldic emblem of Ireland. In Hooker and Arnott's *British Flora* it is remarked that the *oxalis* or wood-sorrel 'appears to be the original *seamrog* or *shamrock* of Ireland, although the name has long been applied to the much less beautiful *Trifolium repens*, or Dutch clover, both in the Irish and Gaelic languages.'

**SHAMYL**, a Caucasian chief, celebrated for his long resistance to the power of Russia, was born in the *aul* or village of Himri, in the north of Daghestan, in 1797. He studied Arabian grammar and philosophy under the Mollah Jelal-eddin, and became a disciple of Kasi-Mollah, whose revival of Sufism had formed a bond of union among the tribes of Daghestan. In 1824 he joined Kasi-Mollah in the struggle which then broke out against the Russians. He was severely wounded in a struggle on 18th Oct. 1831, in which Kasi-Mollah and many of the Caucasians fell. But for his wound he would at this time have been elected chief, and on the assassination of Hamssad-bai, the successor of Kasi-Mollah, in 1834, he was elected head of the sect. During the next four or five years he laboured by a theocratic system of state policy to organize a military power, and inflicted several severe defeats upon the Russians. In 1839 General Grabbe took the mountain fastness of Akulgo, where Shamyl had established his residence. Shamyl escaped and took up his quarters at the fastness of Dargo. Here in 1842 he repulsed the Russians with fearful loss, and in the following year carried his arms into Russian territory. In 1844 the Russians under Woronzof were more successful, but sustained heavy losses in following the Caucasians into their fastnesses. Dargo was captured in 1845 after great exertions, but in 1846 Shamyl invaded and devastated Kabarda. He repulsed Woronzof in an attempt to storm the Russian fortress of Gerghebil, which he had captured, and then retired to his own country. He sustained in 1848-49 a siege of eleven months and

three assaults on the fortress of Akulgo. At this time he lost his wife and son, who were captured by the Russians. In 1850 he again withstood the Russians at the Terek and the Kuban, but after a severe struggle in this and the following year the confidence of his followers began to give way, and he was more and more thrown on the defensive. On the outbreak of the Crimean war he was subsidized by the allies, but the assistance came too late. On the close of the war the Russians renewed their operations in the Caucasus with increased force, and on 6th Sept. 1859, he was compelled, after a struggle in which he lost nearly all his men, to surrender at Ghunib to General Bariatinski. He was sent to St. Petersburg, where he was kindly received. He received a pension of 10,000 roubles, and was allotted the town of Kaluga as a residence. In 1866 he took the oath of allegiance to the emperor. He died in 1871.

**SHANGHAI**, a large seaport town of China, in the province of Kiangsoo, on the left bank of the Whang-poo, about 12 miles above its junction with the Yang-tse-kiang, 47 miles from the bar at the mouth of the latter river, and 150 miles south-east of Nanking. Old Shanghai, or the Chinese city, is inclosed within walls 24 feet high, with six gates, forming an inclosure of about 2 square miles. The streets are singularly narrow and filthy; but recently a mixed committee of natives and Europeans have attempted some improvements. The houses are for the most part of two stories, the lower story usually being a shop. China Street contains the best native shops, from all of which coloured scrolls with large inscriptions project over the thoroughfares. Bookshops are numerous and well supplied; pawnbrokers also are abundant. Throughout the town there are several orphan or founding asylums, the buildings being generally not large, but lofty, airy, and tolerably clean. The Hall of Benevolence is one charitable institution; and near it is a medical college, with a shrine and image of its half-deified founder. Adjoining this is the city prison, divided into wards, with its inmates classified, some manacled and fettered, others confined in low wooden cages. On the north-east side of the town is the Wei-kwan, a tribunal before which all matters in dispute between mercantile men are adjusted; and a temple erected in honour of the goddess of the seas, in which, besides ceremonies and sacrifices, dramas are performed all day long.

The foreign settlement (Shanghai was one of the five ports opened by the treaty of 1843) is adjacent to the walled city, but quite distinct in its boundaries, government, and commerce. It is distant 25 miles from the sea-coast, and surrounded by navigable creeks that intersect the delta, so numerous that within a circuit of 50 miles there are not less than from 2000 to 2500 miles of water communication; and if the ditches for irrigating the land be taken into account, this net-work of waters may be doubled. The widest of these creeks is named the Whang-poo, which is about  $\frac{3}{4}$  mile wide at Shanghai, and increases to over 1 mile at its outlet into the Yang-tze, at the port of Woosung, 14 miles distant by water, and 8 miles by land. The settlement stands on its left bank, below the walled city, from which it is separated by a moat, with several bridges across; and it, again, is divided by two smaller creeks—the Yang-king-Pang and Soochow Creek, the latter being from 150 to 200 yards in width, with one stone and one wooden bridge across it. These water boundaries divide the settlement into three sections, each under the jurisdiction of the following nationalities:—the upper, French; the middle, British; and the lower, American. These are commonly called *concessions*. They are held on a low rent from the

Chinese government under a code of regulations drawn up by the treaty powers. The British section is the most valuable, and the consulates of all the other nations are situated there, except the French and American. Along the bank of the Whang-poo extends a wide 'bund' or quay, with a bulwark of stone and numerous stone jetties, for landing and loading cargo; while the path forms a promenade for the residents from 50 to 80 feet wide. It extends for 1 mile in length, and contains spacious houses surrounded with gardens; the lower stories being often used as stores (godowns) and counting-houses, the upper as residences. Great improvements have recently been carried out, new roads being made, larger and more substantial buildings being erected, including fine villas, &c. A municipal council is elected by the foreign renters of the English and American quarters, and another by the French, whose quarter is separately administered. The subjects and citizens of each nationality are under the protection of their respective consuls, and amenable to the jurisdiction of their courts; or, where the person has no consul to appeal to, he is amenable to the Chinese authorities. Chinese in foreign employ are exempt from imperial jurisdiction. Since 1865 a complete judicial staff has been in existence, forming a supreme court at Shanghai, with jurisdiction over all British subjects in China. Cotton-spinning and ship-building are among the chief industries of Shanghai, and there are silk filatures, flour, rice, and paper mills, furniture and piano works, &c.

The port of Shanghai extends from the upper limits of the Whang-poo, below the native shipping, to Wootung, a distance of 14 miles, of which the anchorage for foreign vessels extends for 4 miles below the settlement. The anchorage is divided into sections, defining the foreign from the Chinese boundary, where all the vessels are anchored abreast, and lettered according to their position, steamers being separated from sailing ships. A foreign harbour-master is appointed by the Chinese authorities, who retain complete control over the conservancy of the harbour and its entrance, and collect all shipping dues, duties on imports and exports, &c., through the imperial foreign maritime customs. Shanghai has water communication with about a third of China, and its trade since the opening of the port has become very extensive, the port being now connected with a system of steamship lines which carry cargo and passengers to and from all parts of the world. By far the largest trade is with Great Britain and her dependencies, but Japan, the United States, Germany, and Russia are increasing their share of it. The gross value of foreign imports in 1900 was £19,550,783, the great bulk of which represented goods re-exported to other ports. The exports to foreign countries for the same year were valued at £16,659,599. The chief foreign imports are opium, cotton yarns and piece goods, metals, kerosene-oil, coal, and sugar; and the leading exports are raw silk and silk piece goods, tea, raw cotton, hides, and native cloths. A considerable share of the coasting trade is in British hands, and both in the home and foreign trade steamers are chiefly employed.

The chief mission establishments in China are at Shanghai. That of the London Missionary Society has a printing-office for publishing religious works in Chinese, from which was issued in one year 500,000 copies of the New Testament for gratuitous distribution, or at a small charge. Connected with the mission is a hospital for the gratuitous cure of native patients, under the charge of a medical missionary, where many thousands attend during the year. The American Presbyterian Mission not only print in

Chinese, but manufacture the metallic types. There is an extensive mission, also, under the auspices of the French Société de la Propagation de la Foi, where the missionaries conform to the dress and manners of the Chinese, with an extensive establishment near the walled city, having a cathedral within its precincts, capable of accommodating 3000 people. Besides this the French have a handsome church in their concession. In the British concession there is an English church, with several chapels and meeting-houses scattered over the other parts of the settlement. Here also is a public library, and a branch of the Royal Asiatic Society. The Chinese population is now about 586,000. According to a consular report for 1900 the foreign population was 6774, of whom 2691 were British.

SHANNON, the largest river of Ireland, if not of the United Kingdom, properly speaking only commences its course when it begins to issue from the south extremity of Lough Allen, but is generally considered to rise at the foot of Mount Cuilcagh, in the north-west of county Cavan, and to perform the first of its course as a tributary of the lough by flowing south-west and joining it on its north-east shore. On issuing from the lough it flows circuitously, though its direct course is nearly south, passing the towns of Leitrim, Carrick, and Lanesborough, and expanding in several lakes, of which the largest is Lough Ree. On issuing from this lough, a little above Athlone, it flows south-west with several large windings, receiving its most important tributary, the Suck, on the right, and a little farther down the less important Brosna on the left, and then expands into the long and irregularly-shaped Lough Derg. On leaving this lough at Killaloe it flows s.s.w. to Limerick, where, beginning to form a large tidal river, with several remarkable expansions, it flows w.s.w. and falls into the Atlantic by a broad estuary, between Loop Head in county Clare on the north, and Kerry Head in county Kerry on the south. A little above Limerick it receives the Mulkerna, and considerably below the Maig and the Deal, which all join it on the left, and the Fergus on the right. The whole length of the Shannon, including its upper part and the length of its lakes, is 254 miles. Its navigation properly begins in the lough, but unfortunately meets with numerous obstructions from tortuous windings, shallows, rocks, and even rapids. Of the last the most serious occur between Castle Connell and Castle Troy, and have been obviated only by cutting a canal. By means of improvements, executed at the cost of above half a million sterling, the navigation is opened for traffic throughout the whole length, from the upper extremity of Lough Allen to Limerick, a distance of 143 miles, forming with the Boyle and Strokestown branches 158 miles of river and canal navigation. Of this, 129 miles between Killaloe and Leitrim is navigable by large steamers. The commercial importance of the whole river has been materially increased by the Grand and Royal Canals, which give a direct communication to Dublin, and also a communication south into the basins of the Barrow and Suir. Vessels of 1000 tons or more can ascend to Limerick. The tide rises in springs 17 or 18 feet, and in neaps about 14 feet. Near the mouth of the estuary, where it is broadest, the velocity of the advancing tide does not exceed 1 mile per hour; but farther up it becomes much more rapid, and has almost the appearance of a bore. Partly in this respect, but much more in the direction of its course, the magnitude of its volume, and other features, the Shannon presents some striking resemblances to the Severn. It contains several varieties of fish, but its most important fishery appears to be that of eels.

**SHANNY** (*Blennius pholis*), a species of Teleostean Fishes belonging to the family of the Blennies (Blenniidae), averaging about 5 inches in length, and distinguished by the deeply-notched dorsal fin. No appendages exist on the head, as are seen in the case of the nearly-allied Blennies. The general colour is a dusky brown, mottled with darker hues. These fishes are bottom-feeders, and inhabit the lower depths of pools and of the sea-coasts. They may frequently be found in holes and crevices of rocks when the tide has receded, the head protruding from the crevice which conceals the body, and into which when alarmed they retreat backwards. These fishes are retentive of life, and may be preserved for so long a period as thirty hours amid sea-weed or in a dry box. Immersion in fresh water soon kills them.

**SHANSEE**, an inland province of China, bounded east by Pe-che-lee and Honan, south by Honan, west by Shense, and north by Mongolia and the Great Wall; area, 65,950 square miles. This province is the original seat of the Chinese people, and many of the events recorded in their ancient annals occurred within its borders. Its rugged surface contrasts strikingly with the level tracts in some of the surrounding provinces, although the lowland parts of it are represented as being well cultivated and terraced. The rivers, which are almost all tributaries of the Yellow River, are numerous, but not large. The Fuen-ho, the largest of these streams, is about 300 miles long, and falls into the Yellow River near the south-west corner of the province, after draining the central part. The north contains some of the favourite imperial hunting-grounds; and the inhabitants find sources of wealth in the coal, iron, cinnabar, copper, marble, lapis-lazuli, jasper, salt, and other minerals, which it affords. The principal grains are wheat and millet, besides a great variety of vegetables, with grapes and other fruits. Besides Tae-yuen-foo, the capital, there are several populous towns in the province. Pop. 14,000,000.

**SHAN STATES**, a series of petty states on the east of Burmah, and north of Siam, occupying an area not well defined. Sometimes they are regarded as including Laos, sometimes as exclusive of it. The northern part of the Shan country, exclusive of Laos, is looked upon as belonging to Burmah (and therefore as British territory), the southern to Siam. See LAOS.

**SHANTUNG**, a maritime province of China, bounded north and west by Pe-che-lee; south-east by the Gulf of Pe-che-lee and the Yellow Sea; and south by Kiangsoo and Honan; area, 53,760 square miles. The greater portion of this province is level, but the peninsular parts of it are hilly, some of the summits rising too high to admit of cultivation. The shores are generally bold, and full of indentations, some of which are excellent harbours, but there is no considerable seaport town along the entire coast. The province is intersected by several rivers. The only considerable one which flows direct to the sea is the Yellow River or Hoang-ho, which, after traversing the province in a north-east direction, flows into the Gulf of Pe-che-lee. The inland navigation is augmented by the grand canal which traverses the west part of the province north-west to south-east, affording great trading advantages, and the transit trade is extensive. Drugs and vast quantities of vegetables are exported; and felt-caps, carpets, and some coarse hempen cloths are manufactured. The province is over-peopled, and the great proportion of the people are very poor; still they appear to be very contented, and attach peculiar importance to this province, on account of its being the birthplace of Confucius and his disciple Mencius; and also because it contains the Tai-shan, or Great

Mount, which forms a favourite resort of devotees from amazing distances. Its capital is Tae-nan-foo. Pop. 29,000,000.

**SHAPINSHAY**, one of the Orkney Islands of Scotland, between the islands of Stronsay and Pomona. It is of irregular form, about 7 miles long and 5 miles broad; area, 6270 acres, a great part of which is under cultivation. The surface is in general low, and comparatively even, but rises to a considerable elevation towards the centre. Along the shore the soil is fertile, producing excellent crops of grain, but inland it is sterile and unproductive. Pop. (1881), 974; (1891), 903.

**SHARK**, a group of Elasmobranchiate Fishes, belonging to the sub-order Selachii (which see), a group distinguished by the fact that the branchiae or gill-sacs exist on the sides of the neck, whilst the pectoral or breast fins are normal in position and of ordinary size—not being largely developed as in the Skates and Rays (which see). The Dog-fishes (which see) belong to the same group as the Sharks, being sometimes included in the same family (*Squalidae*) as the latter forms; and being in other cases separated from them to form a distinct family (*Scylliidae*), whilst the Sharks themselves fall into the family *Squalidae* or *Carcharidae*. The body in the Sharks is elongated and cylindrical, and tapers towards the tail. The nostrils exist on the under aspect of the snout. The teeth exist in several rows, those of the front row being alone employed in mastication, whilst the hinder rows are gradually pushed forwards to replace the front teeth, as the latter are lost or worn away. One or two dorsal fins exist; the first dorsal fin being placed on the back opposite to the intervening space between the pectorals and ventral fins on the lower surface of the body. Numerous genera are included in the family of Sharks, the chief of these genera being *Squalus*, in which the snout is flat and rounded, the nostrils being situated in the middle, between the mouth and front of the snout. The genus *Sphyrna* (*Zygana*) possesses a hammer-shaped head, the eyes existing at each side of the hammer, as it were. In *Galeus* the head is flat and the spiracles (or apertures on the top of the head for admitting water to the gill-sacs) are small. The upper lobe of the tail has one or two notches. In *Mustelus* large spiracles exist, the teeth being arranged in a mosaic-like or pavement-manner. In *Isurus* the gill openings are large, and placed before the pectoral fins. The tail is crescent-shaped, and keeled on each side; and the spiracles are small, and placed behind the eyes. The teeth are flat and three-sided. In *Carcharodon* the teeth are of similar shape, with notched edges. The genus *Cetorhinus* possesses a short blunt snout, and the teeth are minute and conical, the spiracles being small and the gill-openings large. In *Alopias* the upper half of the tail is greatly elongated, the snout conical, the gill-openings small; and the teeth three-sided but not notched. In *Acanthias* a sharp spine exists before each dorsal fin, the head is flat, and spiracles large; whilst *Dalatias* has no spines, a flat compressed head, spiracles behind eyes, small gill-openings, and no notch at the root of the upper lobe of the tail, as in *Alopias*.

The Sharks conform to the ordinary type and character of Elasmobranchiate fishes in that they breathe by gill-sacs or pouches, each of which opens internally into the mouth-cavity, and externally on the neck by gill-slits. Water may also be admitted to the gills through the spiracles already mentioned. The tail is heterocercal—that is, its upper lobe or half is more or less largely developed over the lower lobe. The mouth, as in all *Plagiostomi* (which see), exists on the under surface of the head, a conformation causing these fishes to turn on their backs to bite conven-

ently. The skin is usually provided with bony granules in the form of *placoid scales* (see *SCALES*); and the skin of some of these fishes is used under the name of *shagreen*, in the manufacture of various articles, such as purses, spectacle-cases, &c. The eggs are contained in capsules or cases of horny material, within which the embryos are protected, the egg-cases being moored or fastened by filaments to rocks or fixed objects, and the young form escaping in due time from its covering. The egg-cases of Sharks and Dog-fishes are frequently cast up on the shores, and receive the fanciful or popular name of 'mermaids'-purses', 'sea-purses', and the like. The skeleton never attains a high degree of perfection, but is usually of cartilaginous kind. The skull exhibits no indications of divisions into distinct cranial bones, although the lower jaw is well developed. And, as in Ganoid fishes, the intestine is provided with a *spiral valve* which serves to increase the area over which the food has to pass.

The White Shark or *Lamia* (*Carcharias vulgaris* or *Carcharodon Rondeletii*) is coloured white below and brown on the upper parts. It is probably the best known of the sharks, and is found in most seas, and particularly in the Mediterranean. It is sometimes found off the coasts of Britain. This fish may attain a length varying from 20 to 25 or even above 30 feet. It frequently follows ships in the tropics, attracted probably by the smell of food, and by the chance of having refuse thrown overboard to it. This shark is one of the ferocious species, and many incidents are related of its voracity. Its liver is rich in oil, and for this purpose it is hunted by the Singalese. The fins afford gelatine to the Chinese, and the flesh is eaten by the Pacific Islanders. The Blue Shark (*Squalus glaucus*; see art. *ICHTHYOLOGY*, Plate I., fig. 6) occurs off the southern British coasts about June, but is found chiefly in the Mediterranean Sea. Its colour is slaty-blue on the upper, and white on the under parts. It may attain a length of 8 feet or more, and is exceedingly destructive to shoals of food fishes, pursuing its prey even to the destruction of the fishermen's nets. The Fox-shark, Sea-fox, Sea-ape, or Thresher Shark (*Alopias Vulpes*), is known by the exceedingly elongated upper tail-lobe, which the fish uses after the fashion of a powerful flail. Its colour is slaty-blue above, the colour being mottled with white below. It feeds chiefly on fishes, and occasionally visits our coasts. The average length varies from 12 to 15 feet. The Hammer-headed Shark (*Sphyrna malleus*; shown at the article *ICHTHYOLOGY*, Plate I., fig. 7) is at once recognized by the lateral elongation of the head to form a hammer-like structure, the eyes being borne on the extremities of the hammer as it were. The average length is 7 or 8 feet. The flesh is coarse and unpalatable. It is sometimes seen off the British coasts, and is common in the Mediterranean Sea. It is of fierce disposition, and has been known to attack bathers. Other species of Hammer-headed Sharks are the *S. Tiburo* or Heart-head, and the Broad-head (*S. laticeps*). The Tudes (*S. Tudes*) inhabits the South American coasts, but has been seen in the Mediterranean Sea.

The Porbeagle Shark (*Lamna* or *Isurus cornubicus*) and the Beaumaris Shark (a distinct variety at least of the above) (*L.* or *I. Monensis*) are also two familiar forms inhabiting the British coasts. The Porbeagle may attain a length of from 4 to 6 feet, and is of grayish-black colour on the upper and white on the under parts. The Basking Shark (*Cetorhinus maximus*), 'Sail-fish', or sometimes named the 'Sun-fish' (not the more familiar fish, however, of that name, which see), attains a length of from 30 to 36 feet, and is often found around our

coasts. The names Sail and Sun Fish are derived from its habit of lying motionless on the surface of the water in the sun, and to the sail-like aspect of the high first dorsal fin. The inhabitants of Orkney call this fish the 'Homer', a corruption of 'Hoe-mother'—Hoe being their name for the picked Dog-fish. The gill-apertures are long, and the eyes are placed near the snout. The skin is rough, and the colour is a blackish-brown, with glossy bluish tints. In habits this shark appears lazy and dull, but if injured speedily awakes and makes violent efforts to escape. The Greenland or Northern Shark (*Seymnus* or *Dalatias borealis*) attains a length of 14 feet, and is coloured brown, shaded with deep blue. It feeds upon the carcasses of whales, and even attacks the living whales. It rarely visits the northern British coasts, and is chiefly found in the Arctic seas. The fins are of small size. The Spinous Shark (*Echinorhinus spinosus*) is so named from the presence of the spiny placoid scales scattered over its integument. Its colour is a dull gray on the head and fore-part of the body, the rest of the body being reddish-yellow, with markings of purple and brown colour. The belly is spotted with red spots, and the chin and sides of the lower jaw are white. The average length is 7 or 8 feet.

Of the Dog-fishes more nearly allied to the Sharks, may be mentioned the Eyed or Black-mouthed Dog-fish (*Pristidurus melanostomus*), the Tope or Miller's Dog (*Galeus canis*), the Smooth Hound (*Mustelus vulgaris*), and the Picked Dog-fish (*Acanthias vulgaris*). See also *ICHTHYOLOGY*.

The liver of some sharks contains a large quantity of oil, and they are accordingly caught in great numbers in some places, and the oil extracted. Shark-fishing constitutes an industry of some importance on the coast of Russian Lapland and the northern portion of Norway. The sharks caught here are chiefly the Basking Shark and the Greenland Shark. The former is pursued only by the Norwegians and Finns, as the Russians do not employ vessels large enough to go far out to sea, and this fish does not approach very close to the coast. The Norwegians employ decked vessels of 20 to 30 tons burden, which carry on the fishery as much as 100 or 150 miles from land, at depths of 250 to 300 fathoms. These vessels carry five or six men. On the coast of Norway, farther to the south, other species of sharks are also caught. The Russians use open boats, carrying four men at most, and do not go far from land, but cast anchor near the shore. In order to attract the sharks the fishermen take an old barrel pierced with several holes, pour oil or grease of some kind into it, and sink it to the bottom with stones. The oil or grease escapes slowly, and is carried by the currents to a distance, thus attracting the keen-scented fishes to the place where the boat is stationed. Here they are caught by hooks baited with salted seal's flesh and fastened to the end of strong chains. When a shark is hooked three of the men haul in the chain, while a fourth stands ready with a mallet in his hand weighing about 20 lbs. Whenever the head of the fish appears within reach he hits it a tremendous blow with the mallet, and thus stuns the animal. The other fishermen then turn it on its back, and rip open the belly with a large long-handled knife. The oil being extracted, the swimming-bladder is inflated by means of a small tube and a pair of bellows, and the carcass is thrown into the sea. The reason for inflating the swimming-bladder is to prevent the carcass from sinking, in which case these voracious fishes would dart upon and devour their dead companion, and would disregard the bait. While the men have been occupied with their first capture the other hooks

have done their work, and the rest of the sharks are successively treated in the same manner. This fishery is not without danger, for it sometimes happens that the fishermen, instead of being the pursuers, become the pursued. Occasionally a boat has been surrounded by a dense shoal of these fishes, all eager to devour the occupants. In such a case it is necessary to cut the cable at once, and make for the shore as fast as possible. This, however, is not so easy; the sharks rush after the boat, crowding alongside and in front of it, and endeavouring to smash it with vigorous blows of their tails; or they endeavour to capsize it by swimming underneath. The men have to employ all their strength and all their presence of mind, and these may even prove insufficient, the boat being upset and the crew devoured by these voracious monsters.

**SHARP**, a musical sign, the power of which is to raise the note before which it is placed a semitone. A sharp in the signature of a piece (see *MUSIC*) raises all the notes on the line or space on which it is placed, with all their octaves, a semitone. A double sharp raises a note two semitones, practically one tone. The sign of the sharp is ♯, of the double-sharp X. The converse of the sharp is the flat.

**SHARP, JAMES**, Archbishop of Saint Andrews, was born in the castle of Banff, in May, 1613. His father, the sheriff-clerk of the county, sent him to the University of Aberdeen, to study for the church. He afterwards went to England, and visited both the universities. It is said the cause of his leaving England was the overthrow of Episcopacy, and that he went to England to procure promotion, but failing, and finding Presbyterianism about to be established in England also, he applied to Alexander Henderson, who procured him an appointment as regent in the University of Aberdeen. While in this position he quarrelled with and struck a co-regent, who had been his competitor for office; but his penitence for this offence was so admirable that it procured him the friendship and patronage of the clergy, Samuel Rutherford observing that 'out of the most knotty timber Christ could make a vessel of mercy.' He was afterwards appointed to the parish of Craill. From this time he took an active part in the affairs of the church, and was soon recognized as a leader of the moderate party or Resolutioners. He received a call to Edinburgh, but it was opposed by his own presbytery, and though supported by the Assembly the invasion of Cromwell prevented it from being carried out. During this invasion he was surprised by a party of soldiers and sent a prisoner to London. In 1657 he again visited London as the deputy of the Resolutioners to Cromwell, in reference to their disputes with the Protesters. He appears to have conducted this affair with an address which impressed the Protector, and though the Resolutioners were royalists, they were more favoured by the protectorate than their opponents, whose extreme views were feared. Sharp was deputed by the leading Resolutioners to Monk, after his journey to England to promote the Restoration, he being believed by his brethren to be well qualified to look after the interests of their church, for which Monk professed the utmost solicitude. Sharp received formal written instructions from his employers. Monk sent him to Breda to meet Charles, and another long letter of instructions, together with a letter to the king, was sent him by the leaders of his party. It is said he went recommended by Monk and Glencairn to Charles and Clarendon, as a fit person to establish Episcopacy in Scotland. It seems at least probable that it was during this visit that the treachery to his constituents, which became manifest in his subsequent conduct, was consummated. Burnet repre-

sents Sharp as a humble admirer and imitator of Monk. His letters at this time show plainly in what direction he was veering, but he was obliged for a long time to dissemble, which the simplicity, not to say credulity, of his employers made comparatively easy. He returned to Scotland in August, 1660, with the famous letter from the king to the Presbytery of Edinburgh, in which he promised to protect the Church of Scotland 'as it is settled by law.' Sharp was rewarded on both sides, being appointed (in spite of the opposition of Rutherford) professor of theology in St. Andrews, and chaplain to the king for Scotland. In January, 1661, Parliament met and established Episcopacy by repealing as invalid all acts passed since 1633. Sharp claimed credit for the royal proclamation, and the act recisory as his own scheme. He was now appointed Archbishop of St. Andrews, and went to London with his coadjutors Fairfoul, Hamilton, and Leighton to receive consecration. He was ordained deacon and priest, and afterwards consecrated as a bishop. An act of political treachery is recorded of Sharp after his ecclesiastical deflection, which exhibits him at the lowest point of abject servility to power. He was deeply involved in the policy of the Earl of Middleton, and on the fall of that nobleman had written to London in his favour, but finding his cause hopeless, he denied his own act, and made a humiliating submission to Lauderdale. In 1663 he obtained an order for a high court of commission, in which he took precedence of the chancellor. The odious persecutions of this court intensified his unpopularity. He became also an object of suspicion to the court, which could not dispense with him as an instrument. The king himself despised him, and refused him the post of chancellor, which he was desirous of obtaining on the death of Glencairn. His precarious position reacted on his temper, and made him increasingly vindictive. His insatiable cruelties after the rising at Pentland made his name a by-word of terror throughout the country. In 1667 he was ordered to confine himself to his diocese. In 1668 he was fired at by a preacher named Mitchell, who was executed ten years after on his own confession, in violation of a promise of pardon. On 3d May, 1679, Sharp was murdered, when travelling in his coach along with his daughter, by a party of his enemies headed by John Balfour of Burley, who happened to fall in with him.

**SHARP-SHOOTERS**, the name formerly given to the best shots of a company, who were armed with rifles, and took aim in firing. They are superseded by the better arms and more complete organization of modern armies.

**SHASTRA**, or **SHASTER** (properly *Śāstra*, from Sanskrit *śās*, 'to teach'), signifies a book, but is used specifically of the sacred books of the Hindus. See *SANSKRIT LITERATURE*.

**SHAT-EL-ARAB**. See *EUPHRATES*.

**SHAVE-GRASS**. See *EQUISETUM*.

**SHAWL**, a loose garment worn chiefly by females over the shoulders. The earliest known manufacture of shawls was in Cashmere, where the finest and most expensive shawls still continue to be made. The Cashmere shawls are made of the under-wool of the Cashmere goat (which see). The wool is separated, and spun with great care into thread of exceptionally fine quality. They are made on looms of a primitive type, and so slow is the rate of production and so careful the workmanship that the price of a shawl is exceedingly high, perhaps about £300 for a very fine one. The patterns or designs are worked in by a sort of wooden needles instead of shuttles. Many shawls of the Cashmere type are now made in the Punjab and elsewhere in India;

and similar shawls are woven of silk in Persia. The well-known 'shawl-pattern' is characteristic of these shawls. The manufacture of shawls was begun in Norwich in 1784, and early in the nineteenth century it was introduced into Paisley, but the Paisley shawl industry—like that of other places—has long been in a languishing condition, though it was once the staple of the town. The shawl manufacture was introduced into Paris in 1802; and the Jacquard loom, by which shawls are now usually made, began about this time to come into use. Tartan plaids were made in Scotland long before this.

**SHEA-BUTTER**, a fixed oil obtained from the shea-tree. See BUTTER-TREE and BASSIA in SUPP.

**SHEAR-TAILS** (*Thaumastura*), a genus of Humming-birds, of which the Slender Shear-tail (*T. enicura*) and Cora's Shear-tail (*T. Coræ*) are two familiar species. These birds occur, the former in Guatemala and Central America generally; the latter in Peru between Lima and Callao, and in the Andes valleys. They derive their name from the elongation of the two central tail-feathers of the males; the neighbouring feathers in the latter species gradually lessening in length outwards. The males and females differ widely in colour. The male of the Slender Shear-tail is green on his upper parts, brown on the head, and bronze on the wing-coverts, the tail being black, and the wings purple-brown; while the female is coloured golden-green above and reddish-buff below.

**SHEARWATER**, a name given to a sub-family of Gulls, of which the common Scissor-bill (which see) or Black Skimmer (*Rhynchops nigra*) is a familiar example. These birds inhabit both coasts of the American continent, and as a sub-family are known by the elongated bill with its upper mandible shorter than the lower mandible, by the slender legs, the long wings, and the forked tail. The name 'Shearwater' applies to their habit of skimming close to the surface of the water, with their bills dipping now and then into the sea in search of the fishes, molluscs, and crustaceans upon which they feed. The name Shearwater is also applied to birds of the genus *Puffinus* in the family Procellariidæ or Petrels, nearly related to the above. Four species have been observed in Britain, namely, the Sooty Shearwater (*P. griseus*), the Great Shearwater (*P. major*), the Manx Shearwater (*P. Anglorum*) and the Dusky Shearwater (*P. obscurus*).

**SHEAT-FISHES** (*Siluridæ*), a tribe or family of Teleostei included in the sub-order Malacopteri, and notable as possessing spines in the first rays of the pectoral fins, these spines being capable of being erected or depressed at will. Spines similar in nature to those of the Sheat-fishes were developed in ancient forms of fish-life, and are found preserved as fossils in the older Palæozoic formations, under the name of *ichthyodorulites*. The Siluridæ also evince a likeness to the Ganoid fishes in having the head covered with bony plates. The body itself may be naked or provided with bony plates. The teeth are numerous in the genus *Silurus*, the body being unprotected by scales, and a single small dorsal fin existing near the head. The anal fin is very long. Four or six long tentacular filaments or 'barbules' surround the mouth. The edge of the upper jaw is formed solely by the intermaxillary bones, and the opercula or gill-covers consist each of three pieces. The air-bladder is placed in communication with the ear through the intervention of a chain of ossicles or small bones. Of this family the best known species is the Sly Silurus (*S. glanis*) or Sheat-fish, found in the Swiss lakes and in most European rivers, and frequently attaining a length of 5, 6, or even 8 feet, and a weight of from 50 or 60 to 70 or even 80 lbs.

These fishes swim slowly, and appear to frequent the bottoms of these rivers, and to lie in wait for fishes which may swim past them. Four elongated and two shorter barbules exist, and these fishes are capable of directing these filaments to any point at will. The colour of this fish is dark green above, and a paler green below the lateral line of the body. The body is spotted in an indefinite manner. The belly is coloured yellow, and the fins are tinted blue and yellow. This fish has long been a favourite in experiments with a view to its acclimatization among our native food fishes, but it is doubtful if the *Silurus* will live and thrive in our British rivers. The flesh is said to be coarse, and fatty or gelatinous. A kind of glue or isinglass is made from the swimming-bladder. The eggs of these fishes are of a greenish colour.

Belonging to the same family of Silurids or Sheat-fishes we find the *Malapterurus electricus* of the Nile, one of the fishes famed for possessing slight electrical powers, and which attains a length of from 12 to 15 inches or more. This fish also inhabits the Senegal river.

**SHEATH-BILL** (*Chionis*), a family of birds belonging to the order of Rases (which see), or Scratching Birds. In this family the wings are long and pointed, the tail being of moderate size. The bill is short and stout, compressed, and strongly arched at its tip. The nostrils exist at its base, and are protected by a horny sheath. The tarsi are short and stout. The front toes are long and united at their bases. The hinder toe is short and elevated on the tarsus. The White Sheath-bill (*Chionis alba*) is the best known species. This bird is found on the shores of Australia, New Zealand, and the islands of the Antarctic Ocean. Its colour is a pure white, the legs being of reddish-black colour. Its average length is 15 inches. A sheath-like mass of horny matter invests the base of the bill and covers the nostrils as already remarked, the presence of this sheath giving to these birds their popular name. These birds feed on molluscs, carrion, fishes, Crustacea, and other food which they can pick up on the sea-shores. They much resemble wading birds in habits, and by some naturalists have been classified with the Grallatores. Cook in his third voyage says its flesh is equal to duck, but other accounts represent the flesh as very unpalatable, probably on account of the particular feeding of the bird.

**SHEATHING**, in naval architecture, is an external covering applied to the bottoms of vessels to protect them from barnacles and other animal or vegetable parasites. Copper was for a long time the material most frequently used for sheathing vessels, although its expense prevented it from becoming so general as was desirable. The oxidation of the copper by the sea-water is so rapid that after three or four years' sailing the sheathing has to be renewed, and the old copper is found to have lost several ounces of weight to the square foot. Sir Humphry Davy applied bars of zinc to the copper sheathing in order to prevent oxidation by the action of the electric current, but the sheathing thus protected fouled as readily as an unsheathed bottom. It was thus found that the oxidation of the copper was an active agent in protecting the bottom from organic sources of pollution from the poisonous nature of the substance produced. A metal was subsequently patented by Mr. Muntz, known as Muntz's metal, or more commonly as yellow metal, consisting of an alloy of 40 per cent. of zinc to 60 per cent. of copper. This alloy oxidizes, but much more slowly than copper. It is now extensively used. Various alloys of zinc and tin, and zinc, lead, and tin, have also been tried. Iron protected or galvanized by zinc has also been used. Of late years

felt has been extensively used as an inner sheathing, between the hull and the copper or yellow metal plates. The felt is made with a large proportion of cow-hair, and rendered impervious by immersion in boiling pitch or tar. Copper sheathing is applied in sheets of uniform size (about 4 feet by 14 inches), overlapping each other about an inch, and pierced and nailed at regular intervals with copper nails. The yellow metal is applied in a similar manner. The admiralty have found a zinc sheathing useful to protect iron-plated ships from oxidization.

**SHEBA.** See **SABRANS**.

**SHECHINAH**, a term of Chaldee or later Jewish origin, used to express the visible representation of the divine presence between the cherubim of the mercy-seat of the tabernacle and afterwards of the temple of Solomon. The word is first found in the Targums. It is not used in reference to the second temple. The word appears to owe its origin to a refinement resulting from the desire to avoid describing the presence of God as literal or material. Thus when the Hebrew Scriptures speak directly of God's dwelling in the sanctuary, the Targums paraphrase the expression by introducing the phrase the 'shechinah of God.' The shechinah is supposed to represent a brilliant and luminous cloud typifying the divine majesty.

**SHEEP** (*Ovis*), a genus of Ruminant Mammalia (Ungulata) included in the family Ovidæ, together with the Goats, the latter forming the genus *Capra*. In the Sheep the forehead is flat or concave, and the horns, which are spiral, may be wanting in the females. The hoofs are of triangular shape and shallow behind, and the males do not give out any distinct or specialized odour, as in the Goats. The *crumen* or 'tear-bag' (*lachrymal sinuses*) is wanting, and the tail is long. The skin is covered by a thick woolly coat, or with a covering of flattened hairs. The true and typical members of the genus *Ovis* have no beard.

The Domestic Sheep (*Ovis aries*) is the common form, but of this single species numerous varieties exist, these latter exhibiting marked differences in the character of the wool, in the horns, the shape of body, length of legs, and in numerous other points. The sheep seems to be the most stupid of all domestic quadrupeds, and is probably the only one incapable of returning to a state of nature, even if placed in the most favourable circumstances. It neither knows how to avoid danger nor to seek shelter from the changes of the atmosphere, nor even to procure nourishment, except in abundant pasturage. Its habits are well known. Its products are the flesh, milk, skin, and especially the wool, which employs a vast capital in the manufacture of clothing. The milk, although utilized in other countries, is in Britain solely given up to the nourishment of the lambs. The time allowed for fattening sheep is about three months before they are sent to market, and when they have attained the age of two or three years; unless the fleece be the object, when it may be delayed to the sixth, seventh, or even the tenth year, in a district where they are long-lived. Their ordinary life does not exceed twelve or fifteen years. The fleece is shorn every year, towards the month of May. It is sometimes washed on the back of the animal, but the more usual practice is to shear it without washing, as it then contains an animal oil, which is a great preservative against insects. The Sheep require particular attention afterwards, as they are more exposed to the changes of the weather. At all times they are exposed to numerous maladies, such as rot and staggers. The Sheep breeds freely in Britain, producing one, two, or even three lambs at a birth each year.

Of the varieties of Sheep the Southdown presents

an example of a short-woolled breed, which is also valued for the delicacy of the flesh. The name is derived from the chief centre of its cultivation, namely, the Southern Downs of Sussex, Surrey, and Kent. This breed has been extended throughout England, and has often been successfully crossed with other breeds. The Southdowns form a polled or hornless variety of sheep, and when crossed with the horned Wiltshires the resulting race seem to lose their horns. The Leicester breed of sheep forms an example of a long-woolled variety, which comprises within its limits several sub-varieties. This breed is cultivated in the midland English counties chiefly, and the most celebrated of its varieties is the Dishley breed, inaugurated and extended by Mr. Bakewell, who devoted his energies to the improvement first of the flesh, and then of the fleece. The Dishley breed comprises animals of smaller form than the older Leicestershires.

The Spanish or Merino Sheep appears originally to have been a native of Spain, and to have possessed a wool of long and fine texture. By interbreeding with the Cotswold Sheep of England, some of which were exported to Spain in 1464, the quality of the wool was so vastly improved that the new merino wool threatened to surpass the famous wools of England. The Merino is fed chiefly for the wool, the flesh, although not unavoury, being difficult to bring to a high state of perfection. This sheep has larger limbs than English sheep. Wool exists on the forehead and cheeks. The males have large spiral horns twisted laterally, the females being hornless, or they may occasionally develop small horns. The trouble of breeders of this sheep has been to get a white wool, the black colour frequently cropping out in the fleece. The Merinoes are kept in Spain in large flocks, which may either remain stationary in one locality, or may migrate from place to place. During the summer months the sheep inhabit the mountainous districts, and the winter is chiefly spent in Andalusia, where they remain till the following April. A system of shepherds, controlled by a *mayoral* or chief, manages the huge flocks, which may number 10,000 sheep each. The number of Merinoes in Spain is calculated to be 10,000,000. The way in which the improved sheep is generally bred in Spain is the following:—Whilst the common sheep remains always on the spot where it was born and is housed in winter, the fine-woolled sheep is kept the whole time in the open air, in summer chiefly in the mountainous part of Old Castile or the Montana, and in the lordship of Molina in Arragon, which are the highest parts of Spain, containing the finest pasture. The former affords aromatic plants, which the latter does not. These mountains are covered with oaks, beeches, birches, hazel-bushes, &c., besides producing all the plants which grow in Switzerland. When a shepherd has driven his flock to the place where they are to remain for the summer, he first gives them as much salt as they are willing to lick. The estimated consumption during the five summer months is 20 cwts. of salt for 1000 sheep (perhaps, however, this estimate is too high). Towards the end of July the rams are admitted to the ewes—from five to six rams to 100 ewes; before and after they remain separated. The rams yield more wool than the ewes, but not of so fine quality; three rams or five ewes afford 25 lbs. In the middle of September the sheep are marked on the thigh. Towards the end of summer they are driven in flocks comprising 10,000 individuals, divided into bodies of 1000 to 1200, from these mountainous districts into the southern plains of La Mancha, Andalusia, and especially Estremadura. The journey begins at the end of September, and

during its continuance they enjoy great privileges. Sometimes they travel as much as 25 or 30 miles a day, in order to reach a convenient place for halting. The whole journey from the mountains to the interior of Estremadura is reckoned at about 690 miles, which occupies forty days. The shepherd conducts them to the pasture which they occupied the previous winter, and where most of the lambs were born. Here folds are constructed for the sheep, and huts made of branches for the shepherd. Shortly after their arrival in the winter pasture the birth of the lambs takes place. The barren ewes receive the poorest pasture, the pregnant the next best, and the ewes which have lambed the best. The lambs born latest are put into the richest pastures to acquire strength for their journey. In March the shepherds have much to do to the lambs—cut the tails, mark the nose with a hot iron, saw off the points of the horns, and emasculate those intended for wethers. In April they return to the summer pastures. The flock at this time shows by its restlessness its wish to migrate; some sheep escape, &c., an interesting fact, considering the restlessness of migrating animals at certain seasons. On the 1st of May the shearing begins if the weather is not cold. It is performed under cover. Before shearing the sheep are put into a building consisting of two apartments, from 400 to 800 paces long and 100 wide. As many of the sheep as are to be sheared the next day are taken on the evening into a narrow, long, low hut, called the *sweating-house*, where the sheep, being much crowded, perspire freely. The wool thus becomes softer, and is more easily cut. This practice was also pursued by the Romans. The wool is sorted and washed before being sent away. The sheep are carried to another place and marked, and those which have lost their teeth are killed for mutton.

In Germany the first improvement of native flocks by Merinos took place in Saxony. In the Erzgebirge Hungarian rams had been previously introduced, but as early as 1765 above 200 Merino rams and ewes, accompanied by two Spanish shepherds, were imported into Saxony. In 1778 another importation of the finest Merinos, from the best flocks of Leon and Castile, took place, and important sheep-farms were established. On that of Stolpen, the first established in Saxony, particular care has always been paid to the sheep, and it still affords extremely fine wool. It is said that Spain itself has at present no sheep equal to the stock imported in 1765; and the finest German wool brings a higher price in London than the best Spanish wool. The original German Sheep is at present found hardly anywhere in Saxony, the chief breed being the fine-wooled race, which has originated from the mixture with Merinos. Prussia has made great progress in the breeding of fine sheep, and some of the Prussian wool, particularly that of the Mark and Silesia, competes in the market with the Saxon wool.

The Spanish breed of sheep was first introduced into Great Britain in 1787. Some individuals of the black and spotted kinds had indeed been procured and kept in the parks of noblemen previously, but without any regard to the wool; nor was much interest awakened by the flock imported in 1787. Subsequently great attention was paid to the improvement of English wool, but it was ascertained that though the fleece of the Merino did not much degenerate in England, it did not much improve, and the carcass, which naturally affords little weight of meat, did not better its condition. In consequence of these results the farmers have found it for their interest to return to the native breeds, and to give up the Spanish Sheep. The great object of the agriculturists has been to increase the weight of the carcass and the

quantity of the wool, but it seems very difficult, if not impossible, to accomplish the former without injuring the fineness of the fleece. The number of sheep in Great Britain decreased from over 30,000,000 in 1874 to 26,377,200 in 1901, whilst the number in Ireland in 1901 (4,378,645) is but little less than in 1874. The successful introduction of the Merino in Cape Colony, the Australian colonies, &c., has proved that it will thrive wherever it receives proper care. In hot climates, however, particular attention is required to prevent the wool from degenerating. See Wool.

The Australian Sheep has benefited also by crossing with the Merino, the wool and flesh of the former having greatly improved by the addition of the new race and blood. The Highland Sheep evinces a harder and livelier disposition than other breeds; the horns in particular are large, and their spirals very prominent. The Welsh breed are of small size, and are chiefly bred for the delicacy of the flesh; whilst the Breton sheep are of still smaller bulk. The three foregoing breeds are chiefly cultivated for the sake of the mutton. A breed known as the *Touareg* breed is found throughout Algeria, but the flesh is coarse, as also is the wool, and their chief value consists in their ability to live in situations where other breeds would infallibly starve from want of suitable provender.

Several foreign breeds of Sheep present us with remarkable peculiarities in form and structure. Thus in some varieties the hind-quarters may exhibit a marked tendency to the deposition of fat. Such are the Fat-tailed Sheep of Tartary, the fat on the hinder quarters of which may weigh as much as 40 lbs. The Fat-tailed Syrian Sheep develops fat on the tail itself, which may come to weigh between 70 and 80 lbs; and occasionally a board running upon wheels, and tied to the sheep's hind-quarters, may be affixed by the shepherds to prevent the tails dragging on the ground. A fat-tailed variety also exists at the Cape of Good Hope, and furnishes good mutton. The tail and hind-quarters are together the receptacles for the fat of this breed. The Afghan Fat-tailed Sheep has a large fatty tail, but also possesses a fleece of fine silky wool, much valued for the manufacture of caps, carpets, &c. The Cretan or Wallachian Sheep possesses very large horns, which resemble those of the Koodoo Antelope, and which rise up nearly in a perpendicular manner from the skull, and curve in a spiral manner, the first turn being larger than the others. The fleece is one of soft wool. This sheep inhabits Western Asia and the European borders of that continent, and is found abundantly in Wallachia, Hungary, and Crete. The Moufflon Sheep, of which the Argali (*Caprovius argali*) of Siberia and Central Asia is a familiar example, exhibit bodies of large size. The Argali averages a small ox in size, and is about 4 feet high at the shoulders. The horns are nearly 4 feet long measured along the curves, and they curve downwards and upwards, springing from the forehead. The Bighorn or Rocky Mountain Sheep of North America (*Ovis montana*) is the only species of sheep indigenous to the New World. These sheep measure each about 3½ feet in height at the shoulders, the horns being about the same length. The colour changes with the seasons of the year. The Aoudad or Bearded Argali (*Ammotragus Tragelaphus*) inhabits Northern Africa, and is known by the heavy mane which fringes the front of the body from the throat to the knees. It is found on the Atlas Mountain-range, and averages 3 feet in height at the shoulder, the horns being 2 feet long, and curved backwards.

When we look for the origin of the improvements

which have been made in the breeding of this animal, which has become so important an element of national wealth, and the source of so much manufacturing and commercial industry, we are obliged to go back to the Romans. They had made such progress that the whole system of sheep-breeding at present in use in Spain is essentially the same which was introduced there by the Romans. Columella, who lived under the Emperor Claudius, gives us interesting information on this point. Among other things he says that his uncle, who lived in Bætica (which comprehends the present province of Estremadura), procured some wild African rams at Cadiz, of a coarse fleece, but of an admirable colour. He put them to some finewoolled ewes, and the male progeny being again put to Tarentine ewes, the offspring, with their descendants, united the colour of the sire with the dam's softness of fleece. Other agriculturists undoubtedly imitated him, and thus the purest white was communicated to the black or particoloured native flocks, which, according to Pliny, were common in Spain. The Tarentine Sheep were most celebrated in Italy, and the Milesian in Asia Minor. They were termed *pellice* and *lectæ oves*, from the coverings of skin with which they were clothed, to protect the fleece; they were also denominated *mollæ oves*, not only from the softness of the fleece, but also from the delicacy of their constitution. The attention paid by the ancients to the Sheep was excessive, and the animal was extremely tender; so that we must account for the transition from the ancient sheep to the Merino, which is a hardy animal, thriving in almost any climate, by supposing that other agriculturists imitated Columella, and by crossing the breed imparted a stronger constitution to the finewoolled but delicate sheep of ancient Italy. Strabo, indeed, describes the beginning of this improvement as having taken place in the reign of Tiberius. When the Roman Empire was overrun, and almost all traces of civilization swept away, the Tarentine stock in Greece and Italy, being very tender and requiring the greatest care, became extinct; but the regenerated stock of Bætica, the Merinoes, being able to live in the mountains, survived the conquest of Spain by the Goths and Vandals. Care was early taken in Spain that the improved sheep should not mix with the coarse native sheep, and the government soon took this important branch of national industry under its protection, and established particular courts to have jurisdiction over all subjects connected with sheep, wool, shepherds, pastures, &c. See also WOOL.

**SHEERNESS**, a seaport, dockyard, and garrison town of England, in the county of Kent, at the north-west point of the Isle of Sheppey, on the river Medway, at its junction with the Thames, 35 miles east by south of London. The harbour is safe and commodious, and affords deep water at the lowest tides close alongside the quays. The fortifications are of modern build and immense strength, commanding the entrances to both rivers. The dockyard employs about 1600 men and is principally utilized for the repair of shipping, for which service it is very completely fitted, the costly dockyard extensions at Chatham being found entirely unsuitable for urgent repairs, owing to the rapid silting up of the upper portions of the Medway. Sheerness has barrack accommodation for about 2000 troops and nearly the same number of sailors.—*Sheerness-on-Sea* is the modern portion of the town, lying on the sea-front. It has spacious esplanades, an excellent beach, and affords highly convenient bathing and boating facilities. Since the opening of the new London, Chatham, and Dover Railway station, close to the sea-beach and esplanades, the place is rapidly rising in estimation as a popular summer resort. A death-

rate maintained for many years of under 15 in the thousand attests the healthiness of the district. Pop. (1891), 14,492; (1901), 18,278.

**SHEERS**, two or more spars raised at angles, lashed together near the upper end, and supported by guys; used for raising or taking in heavy weights, also for hoisting or getting out the lower masts of a ship. For the last purpose they are either placed on the side of the quay or wharf, on board an old ship cut down, or in the vessel to be masted or dismasted, the lower ends being placed on opposite sides of the deck, and secured by stays extending to the stem and stern of the vessels. Sheers are also used in ship-building yards.

**SHEET**, a rope fastened to one or both the lower corners of a sail, to extend and retain it in a particular situation.

**SHEET-ANCHOR**. See **ANCHOR**.

**SHEFFIELD**, a municipal, parl., and county borough and city of England, in the county of York (West Riding), pleasantly situated on several acclivities, in a natural amphitheatre, inclosed on all sides except towards the north-east by wooded hills, at the junction of the Sheaf and Don, on the Sheffield and South Yorkshire Navigation Canal, and on the Great Central and Midland Railways, 157 miles N.N.W. of London by rail. The site of the town was originally confined to the angle formed by the two rivers, but has gradually extended to a considerable distance along the slopes which rise from them, and where not densely covered with houses presents many villas and other detached residences, distinguished both by the elegance of their architecture and the pleasantness of their localities. Until recently the central or older parts of the town were irregularly built, the streets steep and narrow, lined with poor-looking brick houses; but the corporation have opened up new streets, widened others, and otherwise greatly improved this quarter. In the more modern parts the streets are both wide and straight, and many of the shops are remarkable for their elegance. The atmosphere is not so much polluted by smoke now as formerly. Almost all the streets are well paved and well lighted with gas. The communication across the Don is maintained by seven bridges, six of stone and one of iron; there are also several bridges over the Sheaf.

The city contains over sixty churches and other places of worship in connection with the Establishment, and about 190 belonging to Dissenters of various denominations, of which the most numerous are the Wesleyan Methodists, Independents, and Baptists. Among the churches the most deserving of notice are the original parish church, a spacious cruciform structure, erected in the reign of Henry I., surmounted by a central tower and spire, and containing, among other interesting monuments, a bust remarkable as the first production of Chantrey's chisel; St. Paul's, a handsome Grecian edifice, with a dome and tower; St. James', with a well-arranged interior, and an east window containing a beautiful painting of the crucifixion; St. George's, St. Philip's, and St. Mary's, covered externally with a profusion of grotesque heads and other ornaments, but well arranged within, and consisting of a nave and aisles, separated by ranges of light clustered columns, which support a lofty and richly groined roof. Among the Dissenting places of worship notice is due to the Wesleyan Brunswick chapel; one or two new Congregational chapels; and the Roman Catholic chapel, a cruciform building in the Decorated style, with a tower and elegant spire 200 feet high. The other more important buildings are the town-hall, comprising fine municipal offices and council-house, built at a cost of £110,000; the Cutler's Hall, a

handsome Grecian edifice, with a Corinthian portico; the Music Hall, with a library and literary society in the same building; the Albert Hall (including a large concert room); the corn exchange, erected at a cost of £55,000; the market-hall; the assembly-rooms, theatre, barracks, public baths; the Victoria Railway-station (Great Central); and the Midland Railway-station. The educational and literary institutions include Firth College, a gift by Mr. Mark Firth, made with the view of providing a local home for university education; Wesley College, occupying a handsome structure; Ranmoor Methodist College, the People's College, the grammar-school, the school-board schools; the school of art; the mechanics' institution; a fine technical school; the athenæum, the literary and philosophical society; the free public libraries, including the central establishment and several branches; and the Ruskin Museum, Meersbrook Park, founded by the late Mr. Ruskin. The principal benevolent institutions are the royal infirmary, the royal hospital, the Jessop hospital for women, the victuallers' asylum, Firth almshouses, and several charities under the cutlers' company. We may also mention the cemetery, situated on the slope of a hill about 1 mile from the town, and covering a well-laid-out area of about 14 acres; Brightside Bierlow Cemetery, near Pitmoor, of 27 acres; and several other cemeteries under public control; the botanical gardens, finely situated near the general cemetery; the Norfolk, Firth, and Weston Parks, the latter of which includes the Mappin Art Gallery and a museum; several other parks and recreation grounds. There are municipally-owned water-works, electric-light works, markets, and electric tramways.

The oldest staple manufactures are all kinds of cutlery, including knives, scissors, razors, edge-tools, files, and reaping instruments; also armour-plates, rails, springs, wheels, tyres, buffers, and all other castings for fixed or rolling stock. In each of these branches great numbers of workmen are employed, and the articles produced are well known and esteemed in all the commercial emporiums of the world. Steel also is made in vast quantities, not only for the supply of the local demand, but of the general market. For this purpose Swedish iron is mostly employed. Another celebrated branch of manufacture is the plating of articles of copper with silver. A great number of hands are also employed on what is called Britannia-metal, which is made to form a cheap substitute for almost all the articles made more expensively from the precious metals; and by the operation of what is termed *pressing*, the horns and hoofs of animals are converted into many useful and elegant forms. Other leading articles are optical instruments, including especially the grinding of spectacle-glasses; and in the more cumbersome articles of stoves, grates, and fenders Sheffield holds a decided pre-eminence both in lowness of price and elegance of design. In connection with the staple manufactures of the town are numerous extensive iron and brass foundries, grinding, tilting, rolling, and slitting mills, &c. The social condition of the workmen is generally superior.

Sheffield is supposed to have been originally a Roman station, and is certainly of great antiquity. It existed as a town under the Anglo-Saxons, and is mentioned in Domesday-book as a manor. In 1296 Edward I. granted it a charter to hold a weekly market and an annual fair; and in the fourteenth century the mention of the Sheffield 'thwytel' or whittle by the poet Chaucer, who flourished under Edward III., indicates that it had already become noted for its cutlery. In the early part of the fifteenth century the domain passed by

marriage to the celebrated soldier, John Talbot, earl of Shrewsbury, who built in the vicinity of the town a manor-house, which possesses some historical interest as connected with the custody of Cardinal Wolsey and Mary Queen of Scots. A splendid castle, erected in the reign of Henry VIII., was completely demolished by the Parliamentarians during the civil war. The history of the earliest manufacture of Sheffield is involved in considerable obscurity, but there cannot be a doubt that, like many other English towns, it profited essentially by the bigotry of the Duke of Alva in the Netherlands, and was abundantly compensated for the asylum which it afforded to the victims of his persecution, by the industry and mechanical skill which they imported. From the date of their arrival its cutlery acquired new celebrity. Its progress as a town has been most marked during the nineteenth century, and latterly it has risen to a prominent place among the great manufacturing towns. Its privileges as a municipal and parliamentary borough were first conferred by the Reform Act of 1832. Since 1885 it sends five members to the House of Commons. It was made a county borough in 1888 and a city in 1893. Pop. in 1871, 239,946; in 1881, 284,508; in 1891, 324,243; in 1901 (as extended), 408,994.

SHEIK (properly *sheikh* or *shaikh*), an Arabic word signifying an aged man or elder, is used generally as a title of reverence, and has come to acquire a great variety of significations. Among the Bedouins and other migratory tribes where patriarchal government prevails, the head of every tribe is called a sheik. The superior of the Mohammedan religious or monastic orders are called sheiks. The chief mufti is called sheik-ul-islam. In general the title is given to learned men, and by a wider extension is used as a common title of courtesy, like Mr.

SHEKEL, a Jewish weight, and also a coin. The shekel, as mentioned in the Old Testament, appears to be always a weight, and there is no evidence of coined money being used by the Jews before the time of the Maccabees. There are shekels and half-shekels with inscriptions in the Samaritan character which are generally attributed to Simon Maccabeus. The average weight of these coins is 220 grains of silver for the shekel, and 110 for the half-shekel.

SHELDRAKE, or SHIELDRAKE, the names given to several species of Ducks (Anatines). The Common Sheldrake (*Tadorna vulpanser*) inhabits Britain, along with a second species, the Ruddy Sheldrake (*Casarka rutilla*). The name of 'burrowing ducks' has occasionally been given to these birds, from their habit of depositing their eggs in the burrows of rabbits excavated in soils of a sandy nature. The eggs generally number ten or twelve, and the nest is lined with grass and with down from the breast of the mother. The sheldrakes are notable for possessing a peculiarity in the anatomy of their trachea or windpipe. At its lower extremity, and before dividing into the two main bronchi or air-tubes (one of which goes to supply each lung), the windpipe of these birds is provided with two expanded appendages of unequal size, and of horny structure. The function of these peculiar structures is probably connected with the voice and the production of sounds.

SHELL, the name applied, in a general sense and indifferently, to the external limy covering secreted by various groups of invertebrate animals, but restricted in a scientific sense to that form of exoskeleton secreted by more or less definite tissues, and forming a structure distinct from these tissues themselves. Thus, popularly, the name 'shell' is applied equally to the exoskeleton of the crab or lobster, to the test of the Sea-urchin or Echinus, or to that of the Foraminifera among the Protozoa, and to the shells of

the Mollusca. It is equally obvious, however, that to these various forms of exoskeleton, differing as they do in essential nature, the name shell cannot be indifferently applied in a strictly logical or scientific sense. And hence the naturalist restricts the term 'shell' to the definite structure secreted by the mantle of the Mollusca, whilst to other forms of exoskeleton he applies the name 'test.' The shells of Foraminifera are thus tests, as also are the shells of Echini; and whilst the name shell may be given to the limy crust of the crabs, lobsters, and their allies, the nature of this latter structure being, however, entirely different from that of the true shells of Mollusca. Thus the shell of the crab or lobster consists of little else than a deposit of lime or calcareous matter within the skin or epidermal tissues of the animal. Such a shell, in other words, is essentially a calcified skin; and as seen in the phenomena of 'moulting,' this limy skin may be got rid of periodically, even to its most ultimate and delicate parts. If we compare this shell with the test or shell of the Sea-urchin we find a similarity of fundamental likeness between them. The deposition of lime in the shell or test of the Echinus is carried out in a more elaborate fashion than in that of the crab, for we find in the former that the test consists of rows or series of plates of definite form, united to each other. The shell in such humble forms as the Foraminifera (see PROTOZOA) bring us nearer to the true type of Molluscan shell than the preceding cases. The Foraminiferal test is secreted by the living substance of the body, from which, however, it is separate and distinct, remaining as a tangible and separate structure after the living animal has disappeared. When we come to the shells of Molluscs we attain a good idea, so far as mode of formation is concerned, of the typical shell. Here we find a tissue surface—the mantle surface (see MANTLE)—provided, which secretes the shell, and provides for its renewal and repair. Moreover, the shell in the Mollusca is organically connected to the body through attachments of the muscles, mantle, and viscera; and hence no periodical moulting or exuviation of the shell is possible in these forms. The shell in Mollusca further grows and increases with the growth of the animal itself. That of Crustacea does not grow after it is periodically formed; the object and use of the periodic moultings of the Crustacean shell being to afford a time when, the body being soft and shell-less, the animal can add to its size, and secrete a new shell or crust adapted to accommodate the increase of body.

Bearing in mind those ideas regarding the homologies and differences between the various forms of shell met with in the animal series, we may next briefly glance at the structure and modifications observable in these varied types of exoskeleton. The shell may be destined for protection and for inclosing the soft parts, as in Foraminifera, Echini, and Crustacea; or, as in Mollusca, it may essentially represent a pneumo-skeleton, that is, a hard structure designed to afford protection chiefly and primarily to the breathing organs of the animal. As such we are prepared, therefore, to find that the shell of the Mollusca always bears a definite relation to the respiratory surfaces; and in its most elementary form the Molluscan shell exists as a simple structure covering the gills and nothing more, as seen in *Carinaria*, *Limax*, &c. In some Cephalopodous Molluscs or Cuttle-fishes, the shell, represented by the internal pen or cuttle-bone, may serve to support the soft parts of the animal. Shells do not consist invariably of lime. Flint or siliceous matter may enter partly or wholly into their composition, as in the shells of Radiolaria, Polycystina, &c., among the Protozoa (which see).

The shells of Foraminifera are calcareous or limy, and are usually composite, that is, consist internally of a number of chambers, the living matter contained in these chambers being, however, of continuous kind. Compound shells of Foraminifera are produced from originally single segments by a process of continuous gemmation or budding, and accordingly as the budding proceeds in a straight or curved direction, so we come to have linear or spiral shells formed. The shells of Foraminifera exhibit three types of structure. The so-called porcellaneous shells consist of porcelain-like matter, homogeneous in nature, and opaque white when seen by reflected light. These shells are not perforated by foramina or apertures through which the pseudopodia or processes of the body (see PROTOZOA) can be protruded. The vitreous or hyaline shells are of transparent glassy texture, and their walls are perforated by apertures. The arenaceous shells consist of particles of sand glued together by the animals, and hence are hardly to be regarded as true shells.

The test of the Echini or Sea-urchins exhibits, in its intimate or microscopic structure, a net-work of carbonate of lime or chalk, together with a basis of animal matter. In Crustacea, such as in Decapoda (Crabs, Lobsters, &c.), the most perfect type of shell exhibits a horny, outer, structureless layer; then intermediately a layer exhibiting *areolae* or spaces; and internally and lastly, a substance or layer of laminated tubular structure. One or two of these layers may be wanting in some cases, as in the Portunida, or certain crabs, in which the outer horny and the areolated layer are alone present.

The shells of Mollusca are formed, as already remarked, by the mantle (see MANTLE and MOLLUSCA)—the delicate membrane which, on opening any ordinary mollusc (such as an oyster or mussel), may be seen lining the interior of the valves or halves of the shell. Shells are not invariably present in Mollusca. They are wanting in Polyzoa, Tunicata or Sea-squirts, and in some Gasteropoda, &c. Sometimes the shell is very rudimentary, and may be visible or concealed entirely by the mantle itself. Mollusca are thus divided into *testaceous* or *shelled* forms and *naked* forms.

Each separate piece of which the Molluscan shell consists is termed a valve. Such shells (for example, those of cockles, oysters, mussels, scallops, &c.), as consist of two pieces, are hence termed *bivalves*. Shells consisting (for example, shells of whelks, limpets, &c.) of but a single piece are named *univalves*; whilst, as in one family (Chitons) of Gasteropoda, the shell, consisting of eight pieces, is named *multivalve*. The shell of most Mollusca, even those which are naked in the adult state, appears in a rudimentary state whilst they are still inclosed as embryos within the egg. As the embryo of naked Molluscs grows this rudimentary shell is cast off; whilst in the testaceous forms the embryonic shell becomes the nucleus of that structure as it exists in the adult; and, as in bivalves, this nucleus is usually placed at the *umbo* or beak of the valves, which part may differ widely from the remainder of the shell.

As regards the chemical composition of the shells of Mollusca they appear to consist of carbonate of lime—exhibiting the atomic composition of calcite—united with a small proportion of animal matter. Occasionally, as in the hard brittle shells of the Pholadidae (which see), or Piddocks, the shell-matter, or rather the limy material, exists in the allotropic form of aragonite, which, being much harder than calcite, serves to render the shells efficient organs for excavating the burrows which the Pholades scoop out in rocks.

Three chief varieties of texture are perceptible in

**Molluscan shells.** The *porcellaneous* shells seen in *Gasteropoda* consist of three layers, which exhibit a similar structure, but differ in the manner in which the structure is disposed. Each layer consists of thin laminae or plates, placed side by side, the direction of the planes of these laminae being different in the different layers. Thus the plates may lie transversely in the central layer and horizontally in the others, or longitudinally in the middle and crosswise in the outer and inner layers. The *nacreous* shells form the second variety, and are known by their pearly lustre, due to the presence of *nacre*, or mother-of-pearl. The lustre of these shells is due to the presence of minute striae, or lines which refract the light, and cause the play of colours and lustres. *Nacre* is in fact made up of numerous closely-packed layers, the edges of which exhibit undulations of their surfaces. The *fibrous* shells are composed simply of successive laminae or layers of prismatic cells. In their living state shells are covered externally by a layer of animal matter, known as the *periostracum*, or *epidermis*, well seen in the fresh-water mussels, for example. This layer may, however, be so delicate as to be almost invisible to ordinary observation.

The shells of *Brachiopoda* (see *MOLLUSCA*) exhibit certain interesting peculiarities of structure, in that they are composed of long flattened prisms, arranged parallel to one another, in a regular manner, and at a very acute angle—of about  $10^{\circ}$  or  $12^{\circ}$ —with the shell surfaces. A series of minute canals perforates the shell-substance of *Brachiopoda*, the canals passing vertically from one surface to the other, and generally widening as they come to the external surface of the shell. The existence of these canals gives the shells of *Brachiopoda* an appearance known by the term *punctated*; and it is noteworthy that in the living *Brachiopoda* the canals lodge processes of the mantle, forming pocket-like or coecal tubes, connected probably with the respiratory or excretory systems. The shells of some *Brachiopoda* (for example, *Rhynchonellidae*) do not possess this canal structure, and are hence termed *impunctate*.

When the valves or pieces of which a shell is composed are equal in size the shell is denominated *equi-valve*—as in *Lamellibranchiata*. It is *inequivalve* when one valve (as, for example, the *ventral* valve of most *Brachiopoda*) exceeds the other in size. If the shell (as in most *Lamellibranchiata*) is more developed to one side of the middle line than to the other it is termed *inequilateral*; but when (as in *Brachiopoda*) both sides are equally developed it is named *equilateral*. The shell of *Lamellibranchiata* essentially and typically consists of a hollow cone with its apex directed more to one side than to the other. The terms applied to indicate the conformation of *Lamellibranchiate* shells are readily understood. The prominent point of the shell is the *umbo* or *beak*. This latter always points in the direction of the mouth, and hence the side on which the mouth is situated is termed the *anterior* side; the opposite side to this latter being named *posterior*. The side at which the shells are articulated, or that where the hinge is situated, is the *dorsal* or *upper* border; the border opposite to this latter, or that by which the shell opens, being in contradistinction termed the *ventral* side or *base*. We measure the *length* of a *Lamellibranchiate* shell from its anterior to its posterior margin; and its *breadth* from the dorsal to the ventral border. The valves in *Lamellibranchiata* lie side by side in the natural position of the animal, and with reference to the included organs, and are hence termed *lateral* in position. In *Brachiopoda* the shells lie dorsally and ventrally in the natural position of the animal, one valve thus lying on top

of the other. The shells in *Lamellibranchiata* are shut or drawn together by the action of either one or two *adductor* muscles. The impressions of these muscles may generally be perceived on looking at the interior of the shells, the anterior adductor being that nearest the mouth or anterior border of the shell. In some cases (as in oysters) only a single adductor muscle is developed, this latter representing the posterior muscle of those forms possessing two muscles. The forms with single muscles are named *Monomyarianae*, those with two being termed *Dimyaria*. The shells of *Lamellibranchiata* are opened not by muscular action but by that of ligaments situated at the hinge, one of which (the *external ligament*) is put on the stretch when the shell is closed, and opens the shell in virtue of its elasticity. The *internal ligament* is situated within the hinge, and usually in pits or depressions of the shell. This latter is also compressed when the shell is closed, and aids in opening the shell by its elasticity. The closure of *Lamellibranchiate* shells is therefore a vital and muscular act; their opening is a purely mechanical feature. In *Brachiopoda* the valves of the shell are both closed by muscles (*adductors*), and opened by special *abductor* muscles. The *hinge* of *Lamellibranchiate* shells may be curved or straight, and may exhibit sets of teeth springing from one valve and fitting into sockets on the opposite valve of the shell.

In *Gasteropoda* the shell is typically a *spiral univalve*; and we may conceive of a simple conical shell (such as that of the Limpet) being converted into a spiral form by supposing it to be firstly long drawn out, and then twisted upon itself from above downwards, either to the right or left side. The apex of the *Gasteropod* shell is usually more or less oblique in position. The *coils* or *whorls* of the spiral shell may either be separated (as in *Vermetus*) or contiguous, and in close contact. Sometimes the whorls lie in one and the same plane, being coiled round a central axis (as in the fresh-water *Planorbis*), and then the shell is named *discoidal*. But generally the *Gasteropod* shell shows the whorls to be wound in an oblique manner, so as to form a true spiral, and shells with this conformation may therefore be named *trochoid*, *turreted*, *turbinate*, &c. An ordinary *Gasteropod* shell shows the whorls wound round a central axis or *columella*; the *nucleus* or *apex* being formed, as already mentioned, by the shell of embryonic life, and the largest or terminal whorl (*body whorl*) showing the *mouth* or *aperture*, which may exhibit various dentations of its margins. When the *columella* or axis of the shell is hollowed, and opens below at the mouth-aperture, the opening is named the *umbilicus*; but it may also be solid and *imperforate*. If the aperture or mouth of the shell is notched for the passage of one or more siphons, the shell is said to be *siphonostomatous*. If, on the contrary, its margin is unbroken and entire, the shell is *holostomatous*.

The shells of *Pteropoda* are generally of delicate glassy structure, and consist either of a dorsal and ventral or united plate, or of a spiral shell. In some extinct forms (for example, *Conularia*) of *Pteropoda* the shell was of large size, and of quadrate shape.

The *Cephalopoda* or *Cuttle-fishes* possess (as in the *Tetrabranchiata*; see *NAUTILUS*) external many-chambered shells, or, as in ordinary cases, *internal* shells, which may be destitute of chambers, or chambered as in the extinct *Belemnites* or in the existing *Spirula*. In the *Paper Nautilus* or *Argonaut* the shell is external, but single-chambered; and is, moreover, not a true shell, but a foot-secretion, being formed not by the mantle but by two of the feet or arms, which are specially expanded and modified for this office.

**SHELL**, in military affairs, a hollow projectile filled with a bursting charge of gunpowder or other explosive. Projectiles are spherical for smooth-bore ordnance, but rifled ordnance fire elongated projectiles, which can be so much heavier than the corresponding spherical projectiles of same calibre. Armour-piercing Palliser projectiles of cast iron with hard and brittle chilled points used to be made, but these are now obsolete. Armour-piercing shot and shell are now made of forged steel under various secret and patented processes, the object being to get a projectile with an extremely hard point and a tough body, so that it will penetrate and not break up against modern hard-surfaced armour. Armour-piercing pointed common shell filled with a large explosive charge are intended to penetrate the comparatively thin armour of ships and burst inside by means of a fuse fixed at their base. Armour-piercing shot are for firing against thin armour without an explosive charge, the object being to obviate the chance of the projectile bursting before it has completed its work on the armour-plate. Common shells are hollow and filled with a bursting charge of gunpowder, lyddite, or other explosive, and generally fitted with a fuse to act on impact (see FUSE, and Plate I. at article GUN). Lyddite is fused picric acid, which is remarkably safe from explosion by friction. Against masonry, the violent detonating high explosive, meeting with the resistance requisite to develop its destructive power, is more effective; but against earthworks, black gunpowder is perhaps superior. With black gunpowder the splinters and fragments of the exploded shell are thrown forwards only, but a high explosive overcoming the forward velocity of the shell bursts it in all directions, hence its back and downward blast is very deadly against troops thick behind cover. Steel shells with black gunpowder only burst in a few fragments; the German field-artillery burst thick-walled cast steel high-explosive shells with a time-fuse, a few feet above the cover. Shrapnel shells are filled with bullets, and have a small bursting-charge just sufficient to release the bullets from the outer cylindrical case. With rifled ordnance the centrifugal force of rotation disperses the bullets in the shape of a cone. Field-service shrapnel have hardened lead bullets, 35 to the lb., requiring a striking velocity of 400 feet per second to disable a man, which gives a limit to their effective range: the British 15-pounder has about 212 such bullets. Shrapnel is *par excellence* the best shell against troops in the open, and is generally burst by a time-fuse a few feet in the air above, and about 100 yards from, the enemy. Segment shells are devised to get the effects both of common and shrapnel shells. In shells of this kind iron segments are placed, on the principle of the arch, inside a thin casing; thus, the shell can resist the external explosion of the powder charge, but its own internal bursting charge easily breaks it up. Ring shells, similar to segment, are much used on the Continent. Case shot, we may here mention, are small balls put in a thin iron cylinder. The shock of discharge releases the balls in the gun, and projects them; they are most suitable for close quarters. Star shells on bursting throw out magnesium stars to light up an enemy's position. Carcasses are hollow shells with three vents, filled with a burning composition and ignited by the flame of the powder charge. The burning composition spurts out of the vents, and thus can set buildings on fire.

**SHELLEY**, MARY WOLLSTONECRAFT, the wife of the poet Shelley, and the authoress of *Frankenstein*, was the daughter of the celebrated William Godwin and Mary Wollstonecraft, and born in 1797. In 1814 she eloped with Shelley to Switzerland, and

after the death of his wife she was married to him (see next article). Subsequently they resided chiefly in Italy, where her husband, with his friend Mr. Williams, was drowned in 1822. While travelling with him she composed her famous romance of *Frankenstein*, which excited an immense sensation. It turns on the supposed discovery by a young student of the principle of life, and the consequent formation by him of a human being. Though somewhat unequal in its execution the working out of this repulsive idea is well contrived, and few descriptions in the department of fiction are more terribly graphic than the scene where the experimenter first succeeds in infusing life into his handiwork. After her husband's death she devoted herself much to literary composition, producing *Valperga*, *The Last Man*, and other works of fiction, several biographies for the *Cabinet Cyclopædia*, two volumes of *Rambles in Germany and Italy*, and lastly arranging and editing her husband's poetical works and miscellaneous writings. Mrs. Shelley died in London on 1st February, 1851.

**SHELLEY**, PERCY BYSSHE, poet, was born at Field Place, Horsham, Sussex, 4th August, 1792. He was the son of Sir Timothy Shelley, a landed proprietor of ancient family. His genius does not appear to have shown itself at an early age unless by eccentricity of conduct. As a child he was fond of wandering by moonlight and inventing marvellous tales. He was brought up till ten years of age with his sisters, and being of a delicate constitution he had acquired an effeminate manner and appearance when he was sent to school at Zion House, Brentford. He found the manners of the other school-boys uncongenial, and their rudeness, with which he was unfitted to cope, filled his mind with images of tyranny and oppression. He went to Eton at twelve, and here his ideas of social tyranny were confirmed. He put himself in opposition to the constituted authorities by refusing to submit to flogging. His rooted conviction of the tyranny of his masters was prejudicial to his progress, as was also a taste for desultory reading; but he made fair attainments in scholarship, and began to write verses, being inspired by Bürger's *Lenore*. Soon after his first effusion he wrote, in conjunction with his cousin Thomas Medwin, six or seven cantos on the story of the *Wandering Jew*. He also wrote two romances, *Zastrozzi*, and *St. Irvyne* or the *Rosicrucian*, published in 1810. In this year he went to Oxford, matriculating at University College. He had now become a close student and constant writer. He published soon after his arrival *Posthumous Fragments of Margaret Nicholson*, verses purporting to be by the mad woman who attempted the king's life. In his second year at the university he published anonymously, apparently as a challenge to the heads of the colleges, to whom it was sent, a scholastic thesis entitled *The Necessity of Atheism*. The authorship being known, he was challenged, and, refusing either to acknowledge or deny it, he was at once expelled. Hume was at this time his great authority in philosophy, but he afterwards, according to Medwin, adopted Berkeleyanism. His study of Plato, which was constant and enthusiastic, appears also to have subsequently greatly influenced his views. He imbibed much of the utopian speculation of Plato on the organization of society, which, together with his belief in the tyranny and injustice of the existing organization, made the breach now caused in his relations with society irreconcilable. After leaving the university he completed *Queen Mab*: a Philosophical Poem, privately printed in 1813, and published without his consent in 1821. It contains a violent and blasphemous attack on

Christianity and the Bible, but it is fair to say that Shelley never approved of its publication, and tried to suppress it. He remained in London for some time after his expulsion before his father would receive him home, and he offended him irrecoverably in 1811 by marrying at Edinburgh Harriet Westbrook, the daughter of a retired innkeeper. She was sixteen years of age, his own age being nineteen. They wandered about England, Scotland, and Ireland for upwards of two years, but after being remarried in England they separated, and she returned with her daughter to her father's house, afterwards giving birth to a son. In 1814 Shelley went to the Continent in company with Mary Godwin, daughter of William Godwin and Mary Wollstonecraft. (See preceding article, and GODWIN, MARY and WILLIAM.) In 1815 his father made an arrangement to allow him an income of £1000 a year, of which Shelley settled £200 on Harriet. In 1816 he published *Alastor, or the Spirit of Solitude*, and other Poems. The same year he and Mary Godwin revisited the Continent, where he formed an intimacy with Lord Byron, afterwards renewed in Italy, and from which the genius of Byron did not fail to draw fresh inspiration. In November, 1816, his wife committed suicide by drowning, and Shelley was deeply affected by this event. Soon after he married Mary Wollstonecraft, by whom he already had a child. By a suit in chancery decided in 1817 Mr. Westbrook obtained the guardianship of Harriet's children at Shelley's expense, the plea being that his atheistical opinions and irregular views on marriage made the father unfit to be intrusted with them. In 1816-18 he resided chiefly at Great Marlow, where he laboured assiduously in relieving the poor. This active benevolence always characterized Shelley. Medwin says he would have given his last sixpence to a stranger in want. At this period he was very intimate with Leigh Hunt, to whom he made a gift of £1400. In 1818 *The Revolt of Islam*, a poem in the Spenserian stanza, appeared, originally printed in 1817 as *Laon and Cythna, a Vision of the Nineteenth Century*, which was immediately withdrawn and modified. Partly from anxiety lest he should be deprived of the children of his second marriage, he left England finally in March, 1818. His Rosalind and Helen was begun in England and completed in Italy. He passed through the Alps into Italy, and stayed for some time with Lord Byron at Venice. He represented himself and Byron, of whose genius he had the most exalted opinion, under the names of Julian and Maddalo in a sketch written after this time. He states himself that he was 'attached to that philosophical sect that assert the power of man over his own mind, and the immense improvements of which, by the extinction of certain moral superstitions, human society may be made susceptible', a description which might almost have answered for the historian Buckle. From Venice Shelley proceeded to Naples, where he produced his *Lines written in Dejection*. After Naples he visited Rome. During this tour he produced two of his greatest works—the *Cenci* (Leghorn, 1819) and the *Prometheus Unbound* (London, 1820). The tragedy of the *Cenci* is considered the least visionary of all his greater works, and the one which exhibits most power of dealing with the realities of life; but the horror of the subject has prevented it from ever becoming popular, and from ever being acted. From Rome he went to Florence and Leghorn, and finally settled at Pisa. In 1819 he wrote the grand Ode to the West Wind, and the *Masque of Anarchy*, his parody Peter Bell the Third belonging to the same period. In 1820 there followed *The Witch of Atlas*, the

burlesque *Swallowfoot the Tyrant*, and some fine lyrics; in 1821 *Epipsychidion*, the *Defence of Poetry*, and *Adonais*, a monody on the death of Keats; and in 1822 *Hellas*, a poem in favour of Greek independence. Shelley had a passion for the sea, and had himself contrived a fast-sailing yacht of a peculiar construction. In this vessel he was sailing along with a Mr. Williams in the Bay of Spezia on the 8th of July, 1821, when both were drowned by, as was long believed, the upsetting of the boat through a sudden squall. In November, 1875, however, it was stated in a letter to the *Times* that an old sailor who had recently died at Spezia had confessed that he was one of a crew that ran into and unintentionally sunk Shelley's boat, their belief being that the rich 'milord Byron' was on board, whom they intended to murder for the money they supposed he had with him. But this story has not been sufficiently authenticated. Shelley's body was recovered ten days after, and being cremated, the ashes were deposited by his friends in the Protestant burying-ground of Rome, but the heart was preserved. Apart from special causes of alienation, Shelley's poetry would never have been popular with the mass of readers. It was largely the result of an over-acute sensibility. His imagination in his more elaborate works carries him beyond the bounds of reality into a world of his own, which is obscurely revealed amid all its splendid imagery. His metaphysics are without a solid foundation in reason; his views of the wrongs of society of which he wished to constitute himself a reformer are for the most part visionary; and the censure of extreme presumption can hardly be withheld from a writer who in his youth rejects all established opinions and attempts not only to remodel society but to frame a universal scheme of things out of his own experience; but in strength of imagination and fertility of fancy, particularly in the power of impersonation, as well as in command of language and appreciation of the beautiful in poetic art, he has had few rivals. The *Prometheus Unbound*, in which he idealizes the creations of Greek mythology, is much admired for its classical spirit as well as for the boldness and originality of his adaptation of the classical forms to his own speculations. The most popular of his works are his minor poems, which appeared from time to time along with his larger pieces, particularly the *Cloud* and the *Skylark*. Shortly before his death he had engaged with Byron and Leigh Hunt in the projection of a periodical magazine, the *Liberal*, which had a short career. A number of his writings did not appear till after his death, such as *Julian and Maddalo*, *The Witch of Atlas*, *The Triumph of Life*, and *The Masque of Anarchy*. Among biographies or memoirs of Shelley are those of Thomas Medwin, Thomas Jefferson Hogg, W. M. Rossetti, Mathilde Blind, G. E. Woodberry, J. C. Jeaffreson (*The Real Shelley*), &c.; and there are Shelley Memorials from Authentic Sources, edited by Lady Shelley (1859); but the most complete life of Shelley is that published by Professor Edward Dowden in 1886. The best editions of his works are those of Buxton Forman, and Dowden.

SHELL-LAC. See LAC.

SHEM, the eldest son of Noah, and ancestor of Abraham, who was the eighth in descent from him according to the genealogies in the book of Genesis. He is said to have died at the age of 600 years.

SHENANDOAH, a river of the United States, which is formed in Virginia by the junction of three streams near Port Republic, flows along the west side of Blue Ridge and nearly parallel to it, and below Harper's Ferry joins the Potomac, of which

it is the principal tributary. Its length from Port Republic is 170 miles, the greater part of which is navigable for small boats. The Valley of the Shendandoh was the scene of numerous military operations in the American civil war, and was devastated by General Sherman in 1864.

**SHERNDY**, a town of Nubia, on the Nile, forming the capital of the tract between the Atbara and the Nile, and anciently known as the Island of Meroe. Being on the road from Senaar and the gold countries in the south to Egypt, and on that from Kordofan and Darfur to Suakim on the Red Sea, nearly all the caravans of the country pass through it. Pop. 10,000.

**SHENSE**, a province of China, bounded on the north by the Great Wall, which divides it from Mongolia, on the east by Shansee and Honan, on the south-east by Houpe, on the south by Sechuen, and on the west by Kansoo; area, 81,190 square miles; pop. 10,200,000. It is traversed by the Peh-ling range, separating the basins of the Hoang-Ho and Yang-tse or Yellow and Great Rivers; is well watered, chiefly by the Wei-ho, Loh, and Wu-ting; produces good crops of wheat, millet, and cotton; rears great numbers of horses, cattle, goats, and sheep; and has mines of iron, copper, lead, coal, and gold. These, with rhubarb, musk, and wax, are the chief exports.

**SHENSTONE, WILLIAM**, an English poet, was born at Hales Owen, Worcestershire, in 1714. His father was a gentleman farmer, who cultivated a moderate estate, called the Leasowes, which was rendered celebrated by the taste of his son. The latter was educated at Oxford, and entertained thoughts of taking his academical degrees, and proceeding to the study of some profession, but was seduced, by obtaining possession of his paternal property, to relinquish all his views of an active life, and occupied himself with rural embellishments and the cultivation of poetry. In 1737 he printed a volume of juvenile poems, which obtained little notice; and in 1740 the Judgment of Hercules. In the following year appeared his Schoolmistress, an archaic poem in the style of Spenser, which is considered his best production. His great object, to render the Leasowes famous for picturesque beauty and elegance, led to expenses which he could not ill support, and he was by no means a happy inhabitant of the Eden which he had created. He died in February, 1763, in his fiftieth year. His works in prose and verse, in three vols. 8vo, were published by Dodsley (1764-69).

**SHEOL** (Hebrew), a Hebrew word frequently occurring in the Old Testament, and rendered in the Septuagint by *hades*, in the Authorized Version by *grave*, *pit*, and *hell*; but in the Revised Bible published in 1885 it is only rendered once by the last term. The word is generally understood to be derived from a root signifying hollow, and taken literally it appears to be represented as a hollow subterranean resting-place of the dead of vast dimensions. The general vagueness of the notions of sheol appear to indicate nothing beyond ignorance of the condition after death, an ignorance which is not commonly supplied by any definite efforts of the imagination. Sometimes sheol appears to represent the grave in a poetical generalization; sometimes the idea of retribution or punishment is associated with it, but never that of future happiness. It seems to have become associated with the idea of punishment about the time of the exile. See **HELL**.

**SHEPHERD KINGS**. See **HYCORS**.

**SHEPHERD'S DOG**, or **COLLIE**. Of all the numerous varieties of the dog no one ranks higher in its own intelligence or in its usefulness to man

than the present. It appears further to preserve a more than varietal identity, and to keep the distinctive features of its breed in every country, and even when interbred with other varieties. The Shepherd's Dog, by some authorities, is accounted the progenitor of the British dogs. It is generally of large size, and of powerful, lithe build. The fur is thickly set. The tail, which in former years was cut, is inclined to be long, and possesses a bushy fringe. The muzzle is notably sharp. The eyes are large and bright. The limbs are strongly made, and the whole frame betokens an adaptation to an open, out-door life. The breed has been crossed with other varieties, chiefly for the purpose of obtaining in sporting dogs the hardy endurance of the Sheep-dog. The cross between the Setter and Collie is the most frequent intermixture, but crosses with the Foxhound and Pointer are by no means uncommon. The intelligence of these dogs is at no time more vividly exemplified than when seen ready to understand and obey the shepherd's orders. Seeming to know each order, the well-trained Sheep-dog will direct the movements of the flock with a speed and correctness equal to that of any ordinary human aid. And the long association with the shepherd only tends to initiate the dog into the peculiarities and disposition of his master, and so to render the commands of the latter the better appreciated by the canine servitor. Youatt says that the sheep in turn should understand the dog as well as the master. If the sheep do not assemble round the dog when alarmed, and so insure his protection, or if the dog himself be not equally careful of the sheep, the true relations of the dog, shepherd, and sheep are misconstrued.

The name Collie or Colley is sometimes specially given to a Scotch variety of the Shepherd's Dog, which, in its most perfect and typical appearance, presents a black and tan colour. The muzzle is said to be sharper than in the ordinary Sheep-dog, and the hair is longer and closer than in the latter form. The so-called *Drover's dog* is a cross between the Sheep-dog and Grayhound, Pointer, or Foxhound. This latter variety does not exhibit the same intelligence as the Shepherd's dog, and is more of a mere guardian during the transit of sheep than a faithful watch and ward.

**SHEPPEY** (that is, *sheep ey* or *isle*), an island of England, in the county of Kent, at the mouth of the Thames, between the estuaries of the Medway and the Swale. It is from 8 to 9 miles long and about 5 broad, separated from the mainland by a branch of the Medway and the estuary of the Swale. Sheerness is at its north-west extremity. The lowlands have long been celebrated for the breeding and fattening of sheep; the uplands are very fertile and devoted mainly to the growth of cereals. Minster Abbey church is of great archaeological interest, as being one of the three earliest built Saxon churches. Sheppey cliffs are rich in vegetable and animal fossils. The island has been gradually encroached on by the sea. Pop. in 1891, 18,607.

**SHEPTON-MALLET**, a market-town of England, in the county of Somerset, situated on a slight acclivity at the foot of the eastern range of the Mendip Hills, about  $4\frac{1}{2}$  miles east of Wells. It has tolerably straight, well-paved, and clean streets, and houses generally well built of stone. In the centre of the market-place stands a remarkably handsome cross, erected about 300 years ago; it is of an hexagonal form, with a column or shaft 60 feet high. The church is of mixed Norman and Gothic styles, and has a fine tower 120 feet high. There are several other places of worship, and an endowed grammar-school. The manufactures of the place comprise silk, velvet, crape, &c., in all of which many hands are

employed. Brewing, the making of boots and shoes, and of Cheddar cheese, are also carried on. There are two railway-stations. Pop. (1901), 5288.

**SHERBET**, or **SORBITTO**, a beverage of the orientals, made of water, sugar, lemon-juice, rose-water, dried fruits, &c.

**SHERBORNE**, a town of England, in Dorsetshire, on the London and South-Western Railway, 18 miles N.W. from Dorchester. The parish church, formerly attached to a monastery, is one of the finest minsters in the south and west of England, and has been thoroughly restored in recent times. It is a cruciform structure, with several chapels attached; the tower, piers, and arches are Norman; the rest later. There are several places of worship for Nonconformists. Other public buildings are Sherborne school (one of the foremost public schools in the country), founded by Edward VI, and occupying what were formerly the domestic buildings of the monastery; a technical and secondary school; and almshouses. The chief manufactures are gloves, silk, blouses, shirts, &c. Sherborne is of great antiquity, having been made the see of a bishop in 705 by Ina, king of the West Saxons. The bishopric was removed to Old Sarum about 1075. The old castle, of which there are remains near the town, was stormed by Fairfax and Cromwell in 1645. The modern castle was built by Sir Walter Raleigh. Pop. (1891), 5290; (1901), 5753.

**SHERIDAN**, **RICHARD BRINSLEY** (christened **RICHARD BRINSLEY BUTLER**), was born at Dublin in September, 1751. His grandfather was Dr. Thomas Sheridan, the friend of Swift. His father, Thomas Sheridan, the lexicographer, was also an actor, the rival of Garrick, and an elocutionist. His mother, Frances Chamberlaine, was an authoress of repute, to whose novels he was indebted for some of his plots. He was sent for a short time to a school in Dublin, and in 1762, his parents having removed to England, to Harrow. He was anything but a diligent pupil, and some of his preceptors regarded him as an impenetrable dunce. Throughout life, indeed, when not stimulated by a special object, indolence was Sheridan's besetting sin; but when he had an object to accomplish he could undergo the greatest toil, and never omitted the minutest detail necessary to secure an absolute success. At Harrow he had formed a friendship with H. Halted, a fellow-student, in conjunction with whom, after leaving the school, he published a translation of the love epistles of Aristænetus. In 1772 he eloped to France with a Miss Linley, a young singer of great beauty and accomplishments, whom he secretly married, marrying her again openly the following year. He fought two duels after his marriage with a rejected rival of the name of Matthews. Shortly before his marriage he had entered at the Middle Temple, but, hopeless of procuring subsistence as a lawyer, and resolved not to make a pecuniary resource of his wife's talents, he applied himself to composition for the stage, and on 17th January, 1775, brought out the *Rivals*. After a temporary failure from bad acting it attained a brilliant success, and the leading characters, Sir Lucius O'Trigger, Captain Absolute, Bob Acres, Lydia Langrish, and Mrs. Malaprop, soon became common property. On 21st November he produced the opera of the *Duenna*. Like the previous piece, it was brought out at Covent Garden, and had a run of seventy-five nights, an unprecedented success. Perhaps a greater compliment was that Garrick started against it Sheridan's mother's comedy *The Discovery*, taking himself the principal character. In 1776 Sheridan completed a contract for the purchase of Garrick's share in Drury Lane Theatre. He took two-fourteenths (£10,000) for himself. It

is not known where he got the money. His first production for Drury Lane was *A Trip to Scarborough*, a mere adaptation of Vanbrugh's *Comedy, The Relapse*. On 8th May, 1777, he produced the *School for Scandal*, in the opinion of critics his master-piece. In constructing this play, which was very carefully elaborated, he combined the plots and dialogues of two distinct sketches. On the success of this piece he took a further interest in the theatre to the extent of £17,000, and in the following year appointed his father manager. In 1779 he wrote a *Monody on Garrick*, and *The Critic*, a farce, which, like his other pieces, was a model of its kind, and shared in their brilliant success. In 1798 he wrote *The Stranger* and *Pizarro*, both adaptations from Kotzebue. In his prosperity he began to turn his attention to politics. He gave his support to the Whigs in some current publications, and in 1780 was elected member of Parliament for Stafford. In 1782 he became under secretary of state; in 1783 secretary of the treasury; in 1806 treasurer of the navy and privy-councillor. He became M.P. for Westminster in 1806, but lost his seat in 1807. His first parliamentary appearance, though unambitious, was a failure, but he set himself with his usual determination to acquire the art of parliamentary speaking, and though he never became a statesman, his fame soon rose high as an orator. His greatest effort was on the impeachment of Warren Hastings. His speech on the Begum charge is described by contemporaries as the greatest speech ever listened to in Parliament. Burke, Fox, and Pitt joined in this opinion. Contrary to the practice of the House at that time, it was greeted with applause on all hands, and the minister asked the House to adjourn, as under the influence of such eloquence they were unable to come to an impartial decision. The speech was not preserved, but another substantially similar was delivered at Westminster Hall and reported. It falls entirely to account for the enthusiasm produced by the parliamentary speech. Another famous oration was that on the liberty of the press, in which he held that it would suffice to maintain the freedom of the country against a corrupt Parliament, a truckling court, and a tyrannical prince. Sheridan's wife died in 1792. In 1795 he married a Miss Ogle, with whom he received a considerable accession of means. He sold his shares in Drury Lane, and bought an estate in Surrey; but his dissolute and extravagant habits, which constantly kept him in want, finally ran through all his resources. In his declining health he was persecuted by duns, threatened with executions, and narrowly escaped arrest by a sheriff-officer on his death-bed. He died 7th July, 1816. Sheridan's plays are especially distinguished for their wit, which, though brilliant, is easy and natural. In plot and character there is little originality, but admirable selection. His wit was studiously polished and refined, and what he borrowed was, if not improved, always at least brilliantly set. The dialogue of the *School for Scandal* has been said to be too brilliant for any human conversation. His very butts and dupes, according to Macaulay, who censures this as a fault, outshine the whole *Hôtel de Rambouillet*. Various lives of Sheridan as well as editions of his dramas have been published.

**SHERIF**, an Arabic title equivalent to noble. It is borne by the descendants of Mohammed. It descends both in the male and female line. Those who possess this rank are distinguished by green turbans and valls, green being the colour of the Prophet. In India they are called *Seyyed*. The latter title is also applied as a merely honorary one.

**SHERIFF**. The sheriff is an officer of great antiquity, and known by a corresponding name in

most countries in Europe. He was called in the Danish *græve*; Swedish, *greve*; Anglo-Saxon, *gerefa*; German, *graf*; and in the Latin of the middle ages *graphio* or *graffo*. Adelung observes that the twelve judges appointed by Odin were called *greve*. Both the officer and the name have, with some variations, been retained in Germany. The *graf* of the Germans is, for the most part, a title of dignity, answering to the *count* of the French and the *earl* of the English; and in some cases it is also the title of a prince, as the *landgraf* or *markgraf*. Among the Anglo-Saxons the *gerefa*, or, as he is called in English, the *reeve*, was an officer of justice inferior in rank to the alderman. He was a ministerial officer, appointed to execute processes, keep the peace, and put the laws in execution. He witnessed contracts, brought offenders to justice, and delivered them to punishment, took bail of such as were to appear before the *shiremote*, or county court, and presided at the hundred court, or *folkmote*. There was a distinction both in the rank and jurisdiction of the *gerefa*. The *shire-gerefa*, *shire-reeve*, or *sheriff*, was probably distinguished by the name of the *king's gerefa*, because he more immediately executed the king's precepts, and sometimes sat in the place of the alderman in the county court. He appears also to have been distinguished by the title of the *heh-gerefa* or *high-sheriff*. The *gerefa* who acted in the tithing was called the *tithing-reeve*; he who acted in the *byrig*, or burgh, a *borough-reeve*; and he who acted in the town the *tun-gerefa*. The sheriff in England is the chief officer of the crown in every county. The custody of the county is committed to him by letters-patent, and he has charge of all the business of the crown therein. During his tenure of office he takes precedence within the county of any nobleman, and is entitled to sit on the bench with the justices of assize. The appointment of sheriffs is annual. The judges and other great officers with the privy-councillors meet annually on the morrow of St. Martin (Nov. 12), and recommend three persons for each county, one of whom is appointed by the crown to be sheriff. The person appointed must have sufficient lands within the county to be answerable to the king and people for the performance of his duties. The acceptance of office is compulsory, and as the writ is issued *durante bene placito*, the office is not determined till a new appointment is made, but a person who has served one year is not liable to serve again till after an interval of three years if there be another sufficient person in the county. Militia officers, practising barristers, attorneys, and certain other persons are exempted from service. The sheriff is keeper of the king's peace and bailiff to the king within the county, and in the latter capacity he is bound to preserve the king's rights. He has under him an under sheriff, bailiff, jailers, and other executive officers. He is also bound to appoint a deputy having an office within 1 mile of the Inner Temple Hall, for the receipt of writs, rules, and orders pertaining to his office. Judicially he superintends the elections of knights of the shire, coroners, &c., and has a jurisdiction in the trial of issues from the superior courts not exceeding £20. The sheriff courts were formerly the highest in the kingdom, but their jurisdiction was restricted by Magna Charta. As the returning officer of the county he exercises various functions in parliamentary elections. He is an officer of the superior civil and criminal courts, it being his duty, ministerially, to execute all processes issuing from these courts. He is liable for wrongfully imprisoning any one, but not for the escape of a prisoner from gaol. The election of the sheriffs of London and Middlesex was granted

by Henry I. to the citizens of London for ever upon payment of £800 a year into the king's exchequer. The office of sheriff was formerly hereditary in some counties, and continued so in Westmoreland till the death of the last hereditary sheriff, the Earl of Thanet, in 1849. The hereditary tenure of the office was abolished by an act passed in 1850.

In Scotland the sheriff is the chief local judge of a county. The office in this form is of considerable antiquity. Formerly the tenure of it was hereditary. There are now three degrees of sheriffs, all of whom are appointed *ad vitam aut culpam*. The sheriff-principal is the lord-lieutenant of the county. By act 20 George II. cap. xliii., he is deprived of all judicial functions. The sheriff-depute, formerly appointed by the sheriff-principal, now by the crown, is the principal judicial sheriff, and appoints his substitutes. The substitutes formerly held office at the pleasure of the depute, but now hold them during life or good behaviour. They must be advocates, writers to the signet, solicitors before the supreme court, or procurators before the sheriff court of three years' standing, and certified by the Lord-president of the Court of Session or the Lord-justice Clerk to be duly qualified. There is an appeal from the decisions of the sheriffs-substitute to the sheriff-depute, and the examination and settlement of these appeals constitutes the chief portion of the functions of the sheriff-depute. The Court of Session has the power to appoint a sheriff *pro tempore* in case of a vacancy.

**SHERIFF-CLERK**, the clerk of the sheriff's court who has charge of the records of the court. He registers the judgments of the court, and issues them to the proper parties.

**SHERIFFMUIR**, or **SHERIFF MOOR**, a plain of Scotland, in the parish of Dunblane, in Perthshire. Here a bloody battle was fought between the army of George I. under the Duke of Argyle, and the army of the adherents of the Stuarts under the Earl of Mar, in 1715. The rebel troops consisted of 9000 Highlanders, while the government troops were 8500 in number. The former had rather the advantage, but the action was not decisive enough to be of any service to them.

**SHERLOCK, THOMAS, D.D.**, Bishop of London, an English divine, was born in London in 1678, and received his education at Catharine Hall, Cambridge, where he obtained a fellowship. He was appointed Master of the Temple in 1704, vice-chancellor of the university in 1714, and Dean of Chichester in 1718, after which he entered into a controversy with Bishop Hoadly, in defence of the corporation and test acts. In 1725 he published *Discourses on The Use and Intent of Prophecy*, intended to obviate the infidel objections of Anthony Collins. In 1728 he was appointed to the see of Bangor, and in 1734 translated to that of Salisbury. He was offered the primacy on the decease of Archbishop Potter, in 1747, but he refused it; and the following year he was translated to the see of London, where he remained till his death in 1761. Bishop Sherlock was the author of the *Trial of the Witnesses of the Resurrection of Jesus*; and his *Sermons* are among the best specimens of English pulpit eloquence extant.

**SHERLOCK, WILLIAM**, an Episcopal clergyman, born in Southwark, about 1641, studied at Eton, and afterwards at Peterhouse, Cambridge, where he took the degree of Doctor of Divinity in 1680. After the Revolution, having refused to take the oath of allegiance to William III., he was suspended from the pastoral office; but on his subsequent compliance he was restored, and in 1691 promoted to the deanery of St. Paul's. His death took place in 1707. He distinguished himself as a polemical divine against the Dissenters, and carried on a controversy with

South relative to the doctrine of the Trinity. His works on practical theology, especially his *Discourses on Death and on Judgment, and Vindication of the Doctrine of the Trinity*, are much esteemed, and have passed through numerous editions.

**SHERRY**, a Spanish wine, produced in the neighbourhood of Xeres de la Frontera, in the province of Andalusia, near Cadiz. Many of the principal vineyards are in the hands of British and foreign settlers, to which probably is to be ascribed the improvement which has certainly taken place in sherry wines. The best soil (*albariza*) consists chiefly of carbonate of lime, with a small admixture of silex and clay, and occasionally magnesia. Red and white grapes are used indiscriminately. When ripe and gathered they are spread on mats, and left to dry for two or three days; they are then freed from the stalks, and the rotten or unripe berries rejected. Being now introduced into vats, with a layer of burned gypsum on the surface, they are trodden by peasants with wooden shoes. The juice is collected in casks, in which the fermentation is allowed to take place, continuing generally from October till the beginning or middle of December. The wines are then racked from the lees, and those intended for exportation receive additions of brandy, seldom more than 3 or 4 gallons to the butt. The new wine is harsh and fiery, but mellowed by being allowed to remain in the wood four or five years, though fifteen or twenty years are required to perfect its flavour. Sometimes bitter almonds are infused to give the wine a nutty flavour. The dry sherry is the most esteemed. The finest variety of sherry is the Amon-tillado sherry, the excellent qualities of which are determined by the nature of the soil and the lie of the district in which it is grown. The sherry wines are shipped for the most part at Cadiz, and are principally exported to England. No wine is more largely imitated and adulterated than sherry.

**SHERWOOD FOREST**, an ancient royal forest in Nottinghamshire, celebrated for the exploits of Robin Hood and his followers. The district in which the forest was situated is in the west of the county between Nottingham and Worksop.

**SHETLAND**, or **ZETLAND**, the most northerly county of Scotland, consisting of a group of islands situated to the north-east of Orkney. With the exception of Fair Isle and Foula, they form a compact group, whose most southerly point, Sumburgh Head, in Mainland, is about 50 miles north-east of the most northerly point of Orkney. Foula lies about 20 miles west of the main body of the islands, and Fair Isle is about half-way between the northern Orkneys and Mainland. The county comprises about a hundred islands and islets, but only about twenty-eight are inhabited. The total area is 362,615 acres, of which about two-thirds represents the island of Mainland. This island has a length of over 50 miles, and a breadth of over 20, but its coast is so much broken up by fiords and bays that no place on the island is more than 3 miles from the sea. The fiords in several places penetrate so far into the land as almost to break it up into several islands. The highest hill in the county is Ronas Hill (1475 feet) in the north-west of Mainland. The surface of Mainland, like that of the other chief islands, is diversified by many fresh-water lochs. To the north and north-east of Mainland, from which it is separated by Yell Sound, lies the island of Yell, the second largest of the group. This island has also a much-indented coast-line. On the north-east of Yell is Unst, the third largest island in the county. The most important of the other inhabited islands are: Whalsay, off the east coast of Mainland; the Out Skerries, to the north-east

of Whalsay; Bressay, separated from the east coast of Mainland by Bressay Sound; Fair Isle, already mentioned; East Burra and Trondra, separated from the south-west coast of Mainland by Clift Sound; West Burra, parallel to the last two, a little farther from the coast of Mainland; Foula, already mentioned, with the second highest hill in the county, namely, The Sneug (1872 feet); Papa Stour, separated from the west coast of Mainland by the Sound of Papa; Muckle Roe, in St. Magnus Bay; Fetlar, a large island east of Yell, from which Colgrave Sound divides it; and Vaila. The coasts of all the islands are prevalently bold and rocky, and the ceaseless action of the waves of the Atlantic and the North Sea has worn them into curious forms of unsurpassed grandeur. The surface is monotonous, being largely peat moes, and altogether destitute of trees. The climate is very equable, but the rainfall is considerable, and severe storms are frequent. In midsummer there is hardly any real night, and in midwinter there is but little real day, but during the long winter nights the aurora borealis may here be seen in all its splendour. Geologically, the Shetland Islands consist of ancient gneissose and other schistose rocks, on which, in some parts, the lower members of the Old Red Sandstone formation rest unconformably. Many beautiful minerals have been discovered, and minerals of some economic importance also occur, such as chromate of iron. Of the total area of the county more than 280,000 acres are mountain and heath land used for grazing, and only about 60,000 acres are under crops, rotation grasses, or permanent pasture. The only corn crops grown are oats and barley, which occupy fully 9000 acres; whilst green crops, consisting almost entirely of potatoes, turnips, and cabbages, are grown on nearly 5000 acres. The area in permanent pasture is about 43,000 acres. Considerable numbers of cattle, sheep, and pigs, mostly of very small size, are reared. The small hardy Shetland ponies are well known throughout the United Kingdom. The manufactures are almost entirely domestic, the chief articles being woollen goods, such as shawls, veils, and gloves, but the most important industries of the county are its fisheries and allied occupations. The herring-fishery is the most lucrative, and has greatly developed in recent times, while considerable numbers of cod, ling, and other fish are also caught. Lerwick, on Bressay Sound, is the capital and only town, and Scalloway, on Clift Sound, another place on Mainland, is the largest village. The Shetland Islands were peopled by the Norse, and for several centuries were under the Scandinavian kings, but since 1468 they have been attached to Scotland. The people still show many signs of their Norse ancestry, and the place-names are almost entirely of Norse origin. The antiquities are numerous and valuable, including many brochs, standing-stones, and tumuli, and the remains of a Roman camp on Fetlar. Shetland unites with Orkney in returning a member to Parliament. Pop. (1881), 29,705; (1891), 28,711; (1901), 28,185.

**SHIBBOLETH**. When Jephthah, at the head of the Gileadites, had defeated the Ephraimites, and his troops wished to intercept their flight across the Jordan, they required those who came and sought to cross the river to pronounce the word *Shibboleth*. The peculiar pronunciation of the Ephraimites, who pronounced this word as *Sibboleth*, betrayed them to their enemies. The word has thence acquired the signification of a kind of test or password. See Judges xii.

**SHIEL**, LOCH, a fresh-water lake in Scotland, on the borders of Inverness and Argyle, lying on the north-west of the latter. It is about 15 miles long, but extremely narrow. It discharges itself by a small streamlet into the sea, near Loch Moidart.

**SHIELD**, a piece of defensive armour consisting of a plate or framework of various shapes and materials, and variously covered and adorned, formerly in extensive use amongst almost all peoples and still used by savage tribes. The shield is of very great antiquity. The spearmen of ancient Egypt used rectangular shields with a semicircular top. These shields were about half the soldier's height, and were generally covered with bull's hide, having the hair outwards. Occasionally they were strengthened by studs and rims of metal. The larger kinds were strapped across the shoulders by a thong, but the smaller bucklers had wooden bars enabling them to be grasped by the hand. The shields of the warriors in the Iliad were of untanned hide and metal, large enough to cover the whole man, and, when not in use, were supported on the warrior's back by means of a leather belt. Many of them bore ornamental and other devices, but in some cases the devices described are evidently elaborated by the poet for special purposes. The shields of later Grecian times were smaller than those of the heroic age. The larger kind used by the heavy-armed infantry was known as the *aspis*, or, in Latin, *clipeus*. Two chief forms of it were recognized, namely, the Argive or circular clipeus, and the Boeotian, an oval form. These clipei were often of brass. Many of them had two handles on the back; through the larger of these the soldier passed his arm before grasping the smaller with his hand. After a war was over, the Greeks often hung their shields in temples, and sometimes special votive shields were made for this purpose. The ornamentation of shields with various devices was a common practice, and it seems to have been adopted partly in order to facilitate the recognition of friends on the field of battle. The clipeus was used in the early days of the history of Rome, but only by the higher class of Roman soldiers, and it was soon altogether abandoned in favour of the Sabine shield known as the *scutum*. The scutum was of wood or wickerwork, either rectangular or oval in shape, and often curved. According to Polybius it was 4 feet long by 2½ broad, or rather larger. The *pelta* was a small, oblong shield of wood or wickerwork covered with skin or leather, and without a metallic rim. It was introduced into Greece by Iphicrates. The *parma* was a round shield, about 3 feet in diameter, carried by the Roman velites and also by the equites. Livy compares with the pelta another kind of shield called the *cetra*, which was used almost exclusively by various barbarian peoples. It was round, and was made of the hide of some animal. The *ancile*, or sacred shield of the Romans, of which the first was supposed to have fallen from heaven in the time of Numa, was somewhat in the form of a figure-of-eight. The ancilia were carefully guarded by priests known as Salii. The shields of the early Franks, the Scandinavians, and the Anglo-Saxons were round. That of the Anglo-Saxons was of wood covered with leather, and had a prominent central boss. The shield of the Normans at the period of the Conquest was large, kite-shaped, and elaborately adorned. In later times this gave place to smaller, though still triangular forms, but with the development of plate armour and the introduction of fire-arms shields became unnecessary and useless. The small round *target* of the Scottish Highlanders was a kind of shield in use as late as the rebellion of 1745.

**SHIELDS, NORTH**, a town and port of England, in Northumberland, on the north bank of the Tyne, near its mouth in the German Ocean, opposite South Shields, and forming part of the mun. and parl. borough of Tynemouth. It extends about 1 mile

along the river, and consists of an older and a more modern portion, the former with narrow streets and lanes, and the latter with spacious streets and squares. The township extends up the river to Willington, and includes Northumberland Dock and Albert Edward Dock. The principal buildings and establishments are the parish church, a chapel of ease, and three new churches; many chapels; national and other schools; an elegant courthouse in the Elizabethan style, a custom-house, town-hall, free library, theatre, assembly-rooms, commodious baths, and various benevolent endowments, among which the most conspicuous is an asylum for decayed master-mariners. The chief industrial establishments are ship-building yards, salt-works, iron-foundries, marine-engine works, and electrical works. Fishing is largely carried on, and much fish is sent to many parts of England. An electric tramway connects the town with several places along the coast. The borough of Tynemouth sends one member to Parliament. For shipping of the port see next article; see also **TYNEMOUTH**.

**SHIELDS, SOUTH**, a mun., co., and parl. bor. of England, in Durham, near the mouth of the Tyne, opposite to North Shields, and communicating with it by a steam-ferry. The older part consists of long narrow streets running parallel to the river; but the modern part, immediately behind, occupies a higher site, possesses many handsome buildings, and has on its east side a kind of suburb containing many pleasant villas. The public buildings and establishments include eight Established churches, one of them with a square embattled tower, another with a spire, and a third with a tower and some fine monuments belonging to an ancient chapel whose site it occupies; a number of chapels for Methodists, Presbyterians, &c.; a neat and commodious town-hall, situated in a large square near the centre of the town, the colonnaded square itself forming one of the finest market-places in the kingdom; police buildings (1893); a custom-house, free library and museum, two theatres, circus, infirmary, fever hospital, public baths and washhouses; nautical college, national and other schools, and several benevolent endowments. The chief industries are coal-mining and coal shipments, ship-building and ship-repairing, marine-engine and boiler-making, and the manufacture of glass, earthenware, chain-cables, and anchors. Coal is shipped principally at the Tyne dock belonging to the North-Eastern Railway Company. A stone pier a mile long has been constructed at the mouth of the harbour. South Shields became a parl. borough in 1832, and sends one member to Parliament. Pop. (1881), 56,875; (1891), 78,391; (1901), 97,233; boundaries since enlarged.—The ports of North and South Shields, formed by an expansion of the river into a wide bay, have been greatly improved and deepened by dredging and the construction of piers, and are capable of containing vessels of any size at their quays. They carry on a very extensive trade, particularly in coal. The registered shipping of North Shields at 31st December, 1900, was 69,131 tons; of South Shields, 38,485.

**SHIITES**, a name given by the Sunnites to all Mohammedans who do not acknowledge the Sunna as a law. The Shiites believe that Ali, the fourth caliph after Mohammed, was his first lawful successor. The Persians are Shiites. See **SUNNITES**.

**SHIKARPUR**, a town of India, capital of a district of the same name in Sind, Bombay, 18 miles west of the Indus and 150 miles south-east of Khelat. It stands in a low plain flooded during inundations of the river, and is surrounded by thriving orchards, date-groves, and orange-planta-

tions. Its buildings are indifferent, and streets narrow and filthy; it has not a single public edifice worthy of note; and two or three mosques, with the bazaar and some massive residences of opulent Hindus, are the only structures reaching mediocrity. Its trade is, however, very considerable. Some cotton goods, scarfs, and carpets are manufactured here. The town stands between two branches of the Sind Canal. Pop. in 1891, 42,004.

**SHILLING**, an English silver coin first struck in the reign of Henry VII. The standard weight of the modern English shilling is 87.27272 grains of silver .925 fine, the remaining .075 being copper. It is the twentieth part of the pound or sovereign, and is equal in value to twelve bronze pence.

**SHIN, Loch**, a lake of Scotland, in the south of Sutherlandshire, stretching north-west to south-east about 24 miles, with an average breadth of about 1 mile. It receives the water of five considerable streams, and discharges south-east by the Shin, which falls into the Kyle of Sutherland. The village of Lairg is situated at the south-east end of the loch, and the Highland Railway passes near it.

**SHINGLES**, a disease consisting in an eruption of vesicles on an inflamed surface of skin, the term being from the French *écaille*, a belt. The eruption consists of red spots and small vesicles which are mostly disposed round one side of the body, like a half belt. In rare cases it encircles the body. It has an obscurely nervous character, occurs in the course of a nerve, and is preceded by stinging neuralgic pains, also by languor, lassitude, loss of appetite, shiverings, headache, nausea, quickened pulse, &c., after which the eruption appears in irregular patches. The vesicles become enlarged to the size of small pearls in 24 to 36 hours, and fresh clusters appear for three or four days, completing the belt-like appearance. As the eruption recedes by the fifth or sixth day, the vesicles become white and opaque, and the red margins become livid or purple. Sometimes the vesicles burst, and several of the patches run together, forming irritable sores, discharging a thin serous fluid, which concretes and forms a crust, that falls off as the parts beneath heal. The disease is not contagious. It is sometimes produced by sudden exposure to cold after violent exercise, and sometimes follows acute affections of the respiratory organs. A similar eruption may appear on the lips and chin in a common cold. The treatment consists in gentle laxatives, and in rectifying any derangement of the system; but the disease must be allowed to run its course, though the irritation can be diminished.

**SHIP**. A ship in the most general sense is a vessel intended for navigating the ocean. In contradistinction to boat, which is the most general term for a navigable vessel, it signifies a vessel intended for distant voyages. A ship is in fact a great boat, but the term is applied to the largest specimens of the ship-building art, and in a more specific sense to a vessel carrying not fewer than three masts rigged with square sails. In the article **NAVIES AND NAVIGATION** we have given a general sketch of the history of maritime enterprise. From relics of ancient ships and specimens of the ship-building of backward peoples it may be gathered that there were two primitive types of ship-building from which all the improvements of modern times have proceeded. These were the raft and the canoe; the one, formed by fixing together planks and spars, gave a floating surface strong and buoyant enough to support a cargo; the other, made by hollowing out the body of a tree and sharpening the ends, gave the rude model of a form fitted for navigation. In like manner there have been from time imme-

morial two distinct modes of propulsion, by oars and sails; the former a purely mechanical and exceedingly simple apparatus for utilizing the yielding and resisting powers of water, the latter a contrivance of greater art for turning to account the natural propelling force supplied by the wind. Which of these modes of building and navigating was the earlier it would be useless as well as unprofitable to inquire. Of the two modes of propulsion each possessed certain advantages which prevented either from entirely superseding the other. Oars have always been the most available in shallow waters. On distant voyages, on the other hand, the unintermitting labour of rowing, and the arduous exertions demanded in contending against heavy seas, would early impress upon the mariners the advantages of sailing by the wind. The difficulties of this mode of navigation, however, made its general adoption a very slow process. For purposes of war, where certainty of movement was indispensable to the success of the manoeuvres of aggression and defence, oars continued to be used; hence the formidable galleys of antiquity with their numerous banks of rowers. (See **GALLEY**.) As an auxiliary force at least oars long continued to be used even in long voyages. Thus we find the Phœnician navigators of the vessel in which Jonah sailed from Joppa to Tarsus toiling in rowing because the wind was contrary.

The ancient art of ship-building, like many other arts, was lost in the overwhelming tide of barbarism which overthrew the last of the great empires of antiquity. The ruder nations of Europe had to begin again in great measure on their own resources. The war galley of the ancients might possibly be so far preserved in the mediæval galleys applied to the same purpose. On the Mediterranean, too, an unbroken line of coasting ships may probably have continued to sail. But it appears evident that the progress made in ship-building under the Roman Empire, not to speak of the Phœnicians and other earlier navigators, was much greater than was transmitted to mediæval Europe. That vessels of great capacity were then built and successfully navigated appears evident from a single example. The ship employed by Constantine to carry the largest obelisk of Heliopolis to Rome, besides the obelisk, weighing 1500 tons, carried 1188 tons of pulse as ballast. It was probably long before another vessel of this size was constructed. Rome absorbed nearly all the earlier forms of civilization, but one curious type of civilization, earlier than that of Rome, the Chinese, had perfected its art of ship-building long before the birth of Rome, and still goes on building its junks with little regard to the superior forms and qualities of the European vessels by which its seas are traversed. The Norsemen attained skill in constructing sea-going vessels of small size; but ship-building made little progress in Europe till the discovery of the compass. The opening up of the passage to India and the discovery of America made another epoch in its progress. Science then began to be applied to the art; but in this indispensable contribution to its progress England took little or no part. Among the southern nations of Europe the credit of building vessels to be propelled by sails alone is usually given to the Genoese. The discovery of the Cape of Good Hope led to the improvement of the Portuguese vessels. In the building of large vessels the Spaniards long took the lead, and were followed by the French, who especially distinguished themselves in the theoretical study of the art. During the seventeenth and eighteenth centuries several continental nations besides the French produced scientific treatises on naval architecture, while England in the same period produced

nothing but a few translations and isolated dissertations. So low had the art fallen in Great Britain that her naval authorities were reduced to copying the French vessels which fell into their hands.

A roll of the English fleet, both mercantile and naval, was made in the reign of Edward III. (1344). At this time galleys appear to have been superseded by sailing vessels. The royal ships were used for purposes of commerce, being hired to merchants. The fleet of Edward consisted of twenty-five vessels, manned by 419 sailors. They appear to have been inferior in size to the merchant vessels of the time. Henry V., who applied himself vigorously to increase the navy, had three large ships, eight carracks, six smaller ships, one barge, and nine balingers. His ships were sold at Southampton in 1423. Henry VII. built a vessel called the *Henry Grace de Dieu*, which is regarded as the parent of the British navy. Her poop and bow were of enormous height, and she was provided with five masts undivided, including the bowsprit. She appears from her form to have been incapable of sailing to a wind, but this manœuvre had been introduced into the royal fleet by the time of Henry VIII. This vessel was built about 1514; she was 1000 tons burthen, and carried 700 men and had about 120 guns. In the art of navigation, as well as in ship-building, the English were at this time greatly inferior to the nations of Southern Europe; but the merchant ships of England were long superior in sailing qualities to those of the navy. In the reign of Elizabeth the English fleet proved its superiority to that of Spain, but was afterwards rivalled by that of Holland. Rapid improvement was made in ship-building during the seventeenth and eighteenth centuries in England as well as the Continent. The first three-decker was built in England in 1637. She was called the *Sovereign of the Seas*, and was deemed the best man-of-war in the world. In 1768 the French adopted three-deckers; and from their application of science they acquired a decided superiority in the size and models of their ships over the English. In the early part of the nineteenth century the lead in improvement was taken by the United States. Adopting, like the English, only experience and previous models as their guide, but with less reverence for custom, they stripped away a multitude of encumbrances with which an accumulation of European prejudices had loaded the larger vessels, improved the models of those intended for fast sailing, and by a return to simpler principles attained results which astonished the world. English builders were at first sceptical as to these improvements; but in 1832 Scott Russell announced his views as to the principles on which speed in sailing depends. These principles had already been applied not only by the Americans but by the Spaniards, and even by some savage nations in the construction of their canoes, but not being founded on theory they had been lost sight of when complicated by considerations of cargo and of accommodation for passengers of high rank, and had finally been replaced by principles which were theoretically false. From the time of their theoretical establishment they were rapidly adopted in England, and a race of improvement began between this country and America, in which the former, having finally the advantage of superior science as well as of greater resources, acquired a decisive superiority. A well-preserved specimen of one of the Viking ships was discovered in a tumulus in Norway in 1880, which shows clearly that the builders of about 1000 years ago had considerable skill as to modelling. The vessel is 75 feet long and 16 feet broad, and was propelled by sail and oars.

The leading qualities of a ship may be comprised under the heads of stability, capacity, strength, and

speed. The stability of a vessel depends on the proportion of her parts and her load and displacement. The displacement of a ship is measured by the volume of water which she displaces when afloat. The weight of this volume of water is of course equal to the entire weight of the ship with her stores and cargo, whilst its bulk is equal to that of the portion of the ship immersed. The capacity of a ship is her power of carrying stores and cargo, together with crew and passengers. The greater this capacity is in proportion to the size, and the greater the speed of the vessel, the greater is her utility. The more lightly a vessel is built the greater will be her capacity for her size; but the lightness of a vessel is limited by the need of strength to resist strain. Capacity is also to some extent dependent on form, and the form which is most conducive to high speed is not necessarily that which gives the greatest capacity for stowage. The speed of a vessel, as also facility of evolution or promptitude in obeying her helm, depends on the due proportion of her parts. In merchant vessels not only the amount but the relative weight and bulk of the cargo is liable to continual variations, as is also the number of persons carried; but in steam vessels the quantity of coals carried varies with the length of voyage and during the time of the voyage.

The Americans first rejected the excrescences which had grown out of European notions of sumptuousness and other prejudices. The high poops, intended for the accommodation of the commander and the superior class of passengers, and the inflected top-sides, which deprived the upper part of a ship of nearly half its breadth and diminished both her capacity and stability, were abolished. The whole top-side being reduced to a uniform level without obstructions the ship also became more manageable and gained in speed. These were great improvements, but they were only a beginning. The Americans soon began also to improve on the lines of the vessel and to experiment on her outline with a view to a higher combination of speed with stability; but here they encountered not only the prejudices of custom but the sanction of law and authority. The established practice was founded on a theory which their innovations contravened. The theory appears to have grown out of the practice, but was not the less implicitly relied on. There were models of vessels which sailed better to the wind and made more rapid way before it than the established forms of European architecture long before these forms were adopted. The lines of the Spanish vessels were originally better than those of the English vessels which succeeded them. The duck form of bow which was ultimately adopted was devised to increase the accommodation for cargo rather than with a view to speed or stability. This expansion of the fore part of the vessel was carried further in England than elsewhere on account of a blundering law for the registration of tonnage, which compelled vessels to pay dues according to a single measure each way. The practice when it had become established, however, was defended by analogy. The whale, the cod-fish, the swan, or the duck were similarly constituted, and that was enough. A theory of the resistance of water was formed in accordance with the established custom. It was held that it was of more importance to the speed of a vessel to facilitate the escape of the water when displaced than to provide for parting it with the least resistance; that as the fluid resists until it reaches the point of greatest breadth and then tends to reunite and push the ship forward, the tapering of the stern is more essential to speed than the sharpening of the bow. Accordingly it was held as an axiom that the point of greatest breadth should be before the centre, and the builders who had the greatest reputation for skill placed it

one-third of the length from the stem. In disregard of this principle the Americans began to taper the bows of their vessels, and, rejecting the convex form of bow, adopted a concave formation as better fitted for cleavage. The result of this diminution of resistance was an increase of speed. The celebrated Baltimore clipper schooners, constructed for sailing in Chesapeake Bay, were admirably contrived for combining stability, capacity, and speed. Broad of beam before the centre but above the water-line, they were adapted for carrying a large amount of canvas. Sharp in the bow, deep in the stern, of great length, and lying low in the water, with long, slender masts, and large sails cut with great skill, they carried large cargoes, held their course without drifting to leeward, and sailed with unusual speed. The same principles were afterwards applied to square-rigged vessels, and produced the famous clipper ships which did so much to develop the trade of India, China, and Australia with both Europe and America. The China tea clippers used to make the voyage home in about ninety-five days. Since the introduction of steam on the tea-clipper run the passage has been made from Shanghai to London in thirty days, the route, of course, by the Suez Canal being much shorter than the sea route by the Cape. The quickest passage of a clipper from Liverpool to Calcutta was made in seventy-one days.

At the time when these improvements were being developed steam was coming into use as a propelling agent in navigation. The earliest successful attempt to apply steam as a propelling agent for commercial purposes was carried out in America by Fulton, who, in 1807, built the *Clermont*, which plied on the East River, New York. In 1812 Henry Bell started the *Comet* on the Clyde. This was the first steam-vessel plying regularly with passengers in Europe. Previous attempts to utilize steam for propulsion of vessels had been tried at various times prior to these above mentioned, but they were more or less experimental. The *Charlotte Dundas* of Symington, built in 1801, was tried on the Forth and Clyde Canal, and towed two vessels successfully at the rate of 3 miles per hour. On account of supposed injury to the canal banks this vessel was given up; but it is of interest to note that she was fitted with a horizontal direct-acting engine of simpler type than many which succeeded her. (See STEAM NAVIGATION.) It had been found that with the old form of vessel an increase of propelling power did not give a corresponding increase of speed, and it was received as an axiom that the resistance of water increased at a higher ratio than the square of the velocity. It was therefore held that a speed of 12 or 14 miles an hour was unattainable, because no vessel could resist the strain of the propelling force necessary to produce it. Scott Russell had seen engines of 50 horse-power taken out of a short broad-bowed steamer and replaced with engines of 75 horse-power, and the gain of speed resulting from this additional force was only about  $\frac{1}{2}$  knot an hour. From such experiences it had been laid down that the practical limit of speed attainable by steam-force at sea was 9 knots an hour. In 1827, while this theory remained unrefuted, American steamers made the passage from New York to Albany, 150 statute miles, in 12 hours, including stoppages, while in 1832 the time had been reduced to 9 hours 18 minutes.

The discrepancy between the results of the earlier experiments and the established maxims necessarily aroused inquiry, and in 1832 Scott Russell announced a new theory, which, together with the numerous experiments subsequently made by him, served to revolutionize the practice of English builders, and

enabled them ultimately to surpass their teachers. From some remarkable experiments made with canal boats Scott Russell conceived he had found the solid of least resistance in moving through water. According to this theory the bow and stern of a vessel should be formed in curves adapted to the form of the two waves produced by the displacement and resettlement of the water, which he called the wave of translation and the wave of replacement. In other words, they are trochoidal curves.

The forms of the lines, however, vary much with the necessities of the case, and present practice does not follow out the wave-line theory. The late Professor Rankine investigated this matter with his usual ability, and divided the resistances experienced under different heads, such as the formation of waves and eddies and surface friction, the latter, at least in a fairly modelled ship, being the principal resistance to be overcome, unless at very high speeds. To the late Dr. Froude we are indebted for much valuable experimental information regarding the law of speed and resistance.

Leaving out of view the exact form of the curve assumed by Scott Russell, it would seem that by diminishing the breadth of the bow in a regular proportion to its entire length from the extreme breadth amidships the minimum of resistance to the forward progress of the ship is presented at each point, and the sum of resistance offered by the entire breadth spread over the largest possible surface, which would seem to admit of the application of the largest simultaneous amount or most economical distribution of power in overcoming it. It would follow from this that depth should be diminished forward as well as breadth, which is in accordance with experience, and also that the longer the bow section in proportion to its breadth, and consequently the finer the lines, the greater will be the maximum of speed attained.

The use of wave-lines or tapering extremities necessitated a great increase in the length of large vessels, and the rivalry which sprung up between the American and English builders soon increased the size of their vessels to such an extent that the strength of the best timber was no longer sufficient to bear the strain imposed upon them. Iron had been used in ship-building by Fairbairn in 1830, and riveted iron plates were now generally substituted for wood in large steamers, the framework and skin being entirely constructed of iron.

The progress of steam navigation is marked by special types of vessels which have been built from time to time. In 1838 the *Sirius* made the first voyage to America. She was a wooden vessel, of 450 tons and 270 horse-power. The *Great Western*, a larger and more powerful steamer, made the passage almost at the same time, but a few days later. In 1843 the *Great Britain* was built. She was a remarkable vessel, built of iron, and 322 feet long. Her first voyage was to New York, the time being nearly 15 days. This vessel was plying to Australia until a comparatively recent date. The first iron steamer belonging to the Cunard Company was the *Persia*, followed by the *Scotia*, the latter being 366 feet long and of 4000 tons. The diameter of the paddle-wheels was 40 feet. These vessels, with the exception of the *Great Britain*, were paddle boats, and the *Scotia* was the last paddle boat of the Cunard Company, the screw propeller superseding the older wheel for sea-going purposes. (See SCREW PROPELLER.) The celebrated *Great Eastern*, built in 1857, measured 691 feet in length, 83 feet in breadth, and 48 feet deep, and had a tonnage of 22,500 tons. She was fitted with both paddles and

screw, the diameter of the former being 56 feet and of the latter 24 feet.

The application of the surface condenser, since about 1862, has, in connection with the compound engine and other improvements, brought the marine engine to its high condition of efficiency of the present day. In recent times there has been a great increase of steam pressures in the mercantile marine, over 200 lbs. per square inch being now common and over 250 having been attained. Moreover, the piston speed has greatly increased, and boilers yield a greater power for a given surface, with the result that the average power has gone up to about 7 I.H.P. per ton of machinery. Great economy in fuel has been effected, the amount per I.H.P. now required being only 1.5 lb. (See STEAM-ENGINE.) About 1889 steamships began to be constructed with twin-screws and a corresponding duplication of the machinery. The advantages of this system for large ocean liners are so evident that it has quickly driven out the single-screw method for the largest kinds of vessels. If one of the sets of propelling apparatus should break down on a voyage the vessel could proceed with lessened speed by means of the other alone; and if the steering-gear should give way at sea the ship could be guided to port by the proper use of the two sets of machinery, at times singly and at other times together.

Some particulars of noteworthy steamships built during and since the last quarter of the nineteenth century may be given here. The *Britannic* and *Germanic* were two sister ships built in 1874 at Belfast for the White Star Line. They were 468 feet in length and 45 feet in breadth, and had a tonnage of just over 5000. The *Aberdeen*, built on the Clyde in 1881, first proved the superiority of the triple-expansion engine, and in the same year the *City of Rome*, now of the Anchor Line, was built at Barrow for the Inman Line. The latter is 600 feet long by fully 52 feet broad, and has a tonnage of 8144 tons. The *Umbria* and *Etruria*, constructed for the Cunard Company on the Clyde in 1885, are shorter than the *City of Rome* (520 feet), but broader (57½ feet). Their tonnage is 7713. The pioneer twin-screw steamers were the *City of New York*, the *City of Paris*, the *Teutonic*, and the *Majestic*, the first two completed in 1889 for the Inman and the last two in 1890 for the White Star Line. The length and breadth of the *Teutonic* are 582 feet and 57 feet 8 inches respectively, and her tonnage is 9686; the *City of Paris* is shorter and broader, and is 10,500 tons. About this time German and French lines began to put out large vessels, such as the *Normannia* and *Fürst Bismarck* (8874 tons) of the Hamburg-American Line, and the *La Touraine* of the Compagnie Transatlantique. The next two notable vessels were the mammoth Cunarders *Campania* and *Lucania* (1893), built on the Clyde, with a length of 620 feet, a breadth of 65 feet, and a tonnage of 12,950. Even these, however, were surpassed by the *Kaiser Wilhelm der Grosse* (1897) of the North German Lloyd, which is 648 feet long, 66 feet broad, and has a tonnage of 14,349; and in 1899 the *Great Eastern* was for the first time exceeded in length by the *Oceanic* of the White Star Line (705½ feet long, 68 feet broad, 17,274 tons). The *Deutschland*, built in 1900 for the Hamburg-American Line, is 686 feet long and 67 feet broad, with a tonnage of 15,500. It has the distinction of having beaten all previous records with a speed of 23.51 knots per hour. Greater than all these, though not intended for record-breaking in the matter of speed, is the *Celtic*, which Messrs. Harland & Wolff of Belfast completed for the White Star Company in 1901. She is the first

steamer to exceed the *Great Eastern* in tonnage (20,880), but in length she is somewhat less than the *Oceanic* (700 feet). Her breadth (75 feet) is less than that of the *Great Eastern*, but her depth (49 feet) is slightly greater. Her engines are of the quadruple-expansion type. There is accommodation for 2859 passengers (2352 third-class) and a crew of 335. A similar but somewhat larger vessel, the *Cedric*, was launched in 1902. Some of the leading shipping companies in Britain are subsidized by the Admiralty in respect of certain ships, which may be requisitioned for naval purposes in time of war. The chief ship-building centres in the United Kingdom are the Clyde (Glasgow, Dumbarton, Port-Glasgow, and Greenock), the Tyne (Newcastle), the Tees (Middlesbrough, Stockton), Hartlepool, the Wear (Sunderland), Belfast, Dundee, the Humber (Hull and Grimsby), Leith, Aberdeen, Liverpool and Birkenhead, London, and Barrow. The chief foreign ship-building countries are the United States, Germany, France, Italy, and Norway.

Many of the ocean-going steamers are now fitted with the electric light in the saloons and cabins, and both the dining and the sleeping accommodation is arranged so as to be more or less in the middle of the vessel, so that the action of rough weather is reduced to a minimum. What are called bilge keels have been successfully adopted in some cases to prevent rolling. Steam steering-gear has also been introduced, giving great command over the very large vessels now constructed.

In designing a ship we have to consider the service for which she is intended; after the dimensions and form are fixed we proceed to 'lay down the lines'. The midship area is reckoned, and a midship section made from which the proportions of the other parts of the ship are calculated. The whole plan of the ship is then drawn in three related sectional plans, called the sheer-plan, the body-plan, and the half-breadth plan. The sheer-plan is a projection on a vertical longitudinal plane dividing the ship into two parts, and gives a complete view of the side, representing the length, depth, rake of the stem and stern, with the wales, water-lines, decks, ports, masts, and channels. The body-plan is a projection of the largest vertical and athwart-ship section, showing the breadth, and having described upon it every timber composing the frame of the ship, those running forward from the place of greatest breadth being described on the right hand, those running aft on the left. The half-breadth plan shows the half-ship lengthwise as seen from above. The water-lines are drawn on the sheer-plan as parallel straight lines; they are dotted in or drawn in blue ink on the half-breadth plan, and show the width and horizontal curves of the hull at different levels corresponding with the water-lines in the sheer-plan. Half-models of the vessel are also made. These are constructed of thin strips of wood laid horizontally on each other, which represent the parallel water-lines, and can be taken apart to serve as models for the full-sized drawing.

When the plans are complete full-sized drawings are traced in chalk on the floor of a room called the mould-loft, which is usually of a length equal to half that of the largest ship, in addition to the whole height of her hull. This operation is called laying off the ship. It supplies the workmen with the exact shape and position of that which constitutes what is called the *frame* of the ship. Pine models are then made of the different parts.

The material formerly used in ship construction was timber, but this is now superseded by iron, and iron again is being in many cases replaced by steel. Wood is only now used for the smaller sea-going

vessels, coasting craft, and small yachts and boats. The materials commonly used for wooden vessels are oak, teak, cedar, pine, beech, elm, and many others, some being more suitable for one purpose, and some for another. In forming the separate pieces of the frame, which is technically called the conversion of the timber, the principal points to be studied are the use of the proper wood to give the requisite strength or toughness to each part; the selection of pieces from which the most important parts can be cut in the most perfect manner, and all the frame made as strong and free from faults as possible; and lastly, the economical use of timber. The last object is often found to be practically antagonistic to the others, for though a small gain which sacrifices the efficiency of a costly machine can never be dreamed of as economy, it is not always easy to hit the exact mean between waste of material and sacrifice of efficiency; and when a low prime cost is an object false economy is often practised deliberately. It is one of the advantages of the use of iron that the cost of material can be more exactly proportioned to the degree of efficiency it is designed to secure.

The keel is usually made of elm, which is tough and not easily injured by water, and is very suitable for receiving the numerous fastenings necessary to fit the other parts into it. In large vessels the keel is usually made of several pieces of timber scarfed together. The keel is not perfectly horizontal, but deeper at the stern than the bow, which gives the ship greater steadiness and freedom of motion. Below the keel is placed the false keel, of elm 4 to 5 inches thick, which protects the true keel from abrasion, and gives greater steadiness to the ship. At both ends of the keel is placed the *dead-wood*, which, cut into a curvilinear form at its upper surface, forms the line of the bottom of the ship's body. The stem and stern posts are set up at each extremity. The stem-post is curved at its lower extremity. In a large ship it is divided into three pieces, called upper, lower, and middle. The scarf which unites the stem-post with the keel is called the *boxing*. The stern-post is, if possible, made of one piece of oak, so as to have greater strength to support the rudder. It is inserted into the keel by tenons and mortices. The frame of the ship consists of floors, cross-pieces, futtocks, and top timbers. The floor timbers are placed across the keel perpendicularly to its length, the upper surface of the keel and dead-wood being cut to receive them. They are fastened in various manners. The timbers which join the floor are called the first futtocks. Other floors and futtocks are placed upon the first to complete the frame. The timbers of the frame below the surface of the water are curvilinear, above it nearly rectilinear. The distance between the frames is called *room and space*. Upon this the relative weight and strength of the ship greatly depend. The stemson is worked in as a support to the stem; the keelson, placed above the keels, serves to secure the floor timbers, and is scarfed to the stemson and sternson, which latter is bolted to the stern-post. The beams which support the decks are received on longitudinal ribs called shelves, which form part of the frame, and above which are the water-ways. The frame being completed the skin or planking is applied, the vessel being first set upright, and plumed to ascertain that her frame is duly proportioned. The outer planking of a large vessel of oak is 3 to 6 inches thick. It is fastened to the ribs by bolts and trenails, or by plugs of oak tightened by wedges. The decks of a ship are not completely flat, but are set to the segment of a large circle, which enables them to throw off the water. The holes for carrying away the water are called scuppers. The seams of

the outer planking of a wooden vessel are made water-tight by caulking. This is forcing oakum (see OAKUM), by means of sharp iron wedges called caulking-irons, into the seams of the planking, which are forced open by reeming irons. The seams are then payed with melted pitch. The decks are also caulked with oakum. Copper sheathing (see SHEATHING) is generally applied after the ship is launched.

For ship-building purposes iron and steel have been found by experience to be greatly superior to wood. An iron vessel is lighter than a wooden one of the same size, and with iron the same strength may be obtained with less weight. Iron is also far more manageable than wood, as it can be bent with ease into any required shape. Steel is a still lighter material than iron. The same names for the different parts are generally retained in building with iron or steel, though they have little correspondence with the parts of a wooden vessel except in position. The keel is of far less importance than in wooden ships, and does not as in them hold the position of foundation or 'back-bone' to the whole structure, since an iron vessel ought to be mutually supporting throughout. An iron ship, in fact, resembles a tubular iron bridge (see BRIDGE, TUBULAR) closed at both ends, and the deck is of as much importance as the bottom to the strength of the whole. The keel is constructed of plates riveted together, and sometimes is made hollow. From it, and riveted to it on either side, rise the ribs, which are girders built up of plates, and to the ribs on the outside is fastened the plating. The plating consists of sheets of iron-plate overlapping each other at the edges, where they are riveted together. The plates vary in thickness according to position and strength required. There may be an inner skin of plating as well as an outer, and this of course adds to the strength and safety of the vessel. The ribs are tied together and at the same time held apart by beams of iron, which support the deck or decks. The decks consist of wooden planking with thin metal plates below. In the finer class of ships there are water-tight partitions or bulkheads of iron stretching across the vessel from side to side and from keel to deck, with water-tight doors in them, so that if in case of an accident the water gets into one of them the rest may keep the ship afloat. For war-vessels protected by enormous plates of iron or steel see WAR-VESSELS.

The launching of a vessel is a delicate operation, and, as marking the completion of the more important labours of the ship-builder, is frequently made the occasion of a public exhibition and celebration. Two parallel inclined platforms of solid timber are laid one on each side of the keel, at the distance of a few feet from it and extending from the stem as far below the stern as can be reached at low water. In this position they are carefully and firmly blocked and supported throughout their length. This double platform is called the *ways*. Upon it a second system of timber is loosely laid, and well greased between. The space from these last to the ship's bottom is everywhere filled with wedges of soft wood fashioned to its curves. The whole is called the *cradle*. The extremities of the cradle at the bow and stern are bound tightly across the keel with chains or ropes, and it is further kept from spreading by stout mouldings, which overlap the outer edges of the ways. When the rising tide has reached well up the ways the wedges are simultaneously driven on every side, and the ship is raised from the blocks on which she has hitherto rested, and made to repose entirely on the cradle. The shores are all removed except the two spurs or dog-shores near the stem, and when the proper moment has arrived these are also knocked away by falling weights, the rope holding up which is cut

when all is ready. The vessel, now abandoned to her weight, and encouraged by the yielding of the greases, begins slowly falling along the inclined plane; her motion becomes at each moment more and more rapid until finally the noble fabric has abandoned its union with the land, and entered upon its destined element.

There are various rules for sparring ships, all founded upon their length and breadth, which are the main elements of stability. We shall here confine ourselves to the *ship*, par excellence. It may be sufficient to name one simple rule for the length of the main-mast, this being the prime mover: deduct one-twelfth from the vessel's extreme breadth, multiply the result by 2; this will give height of mast from deck. The top-mast may be three-fifths of the lower mast, the main-yard seven-eighths of the same, and so on upwards. The fore-mast may equal seven-eighths of the main, with upper masts and yards in proportion. The mizzen-mast, if stepped on the keelson, is five-sixths of the main-mast. The best rules on this subject are perhaps found in tables accurately prepared, in which the lengths of the masts are given in fractions of the ship's breadth, and those of the yards in fractions of the length. For the rest, it will be in most cases necessary to modify any given rule, in all instances, with immediate reference to the particular model of the ship, and to the uses for which she is destined. It would be an advantageous improvement in merchant ships, not spared to the extent of their capacity, to make the fore and main masts in all cases of equal dimensions. With improved appearance they would have all the respective spars and sails, except the courses, answering equally for both masts. This would enable them to go to sea with fewer spare ones, or to derive more advantage from the usual number. In small ships all the spars are of single sticks of pine timber, which, for equal contents, are always stronger; but for ships above 600 or 700 tons it is impossible to procure single trees sufficiently large; and then it becomes necessary to resort to made masts (so called), which are of oak and pine, very artificially put together, and bound with stout hoops of iron. Hollow iron masts are also frequently used.

Many large vessels are fitted with four masts, some with five. The standing and part of the running rigging are formed of wire rope. The masts and bowsprit of a ship are not abandoned to their own unsupported strength, but require to be sustained by the standing rigging. This consists, for the bowsprit, of gammoning and bob-stays, confining it down to the stem; and shrouds, which sustain the immense lateral pressure which it endures when on a wind. The jib-boom and flying jib-boom are in like manner supported by means of martingales and guys. The fore-mast is supported by three or four pairs of shrouds on either side, and by two stays led forward to the bowsprit. The fore-top-mast is supported by shrouds setting up in the top, back-stays descending to the channels (broad pieces of planks fixed edgewise to the outside of the vessel for spreading the lower rigging), and stays leading to the bowsprit end. The top-gallant and royal masts have also their shrouds setting up through the cross-trees, their back-stays descending to the channels, and their stays leading to the jib and flying-jib booms. In like manner are the main and mizzen masts supported, except that the main-stays set up on deck beside the heel of the bowsprit, the main-top-mast-stays at the head of the fore-mast, the main-top-gallant-stay to the fore-top-mast-head, and main-royal-stay to the fore-top-gallant-mast-head. The mizzen-stay also sets up beside the main-mast, and the same in ascending. The running rigging consists of the tacks and

sheets that serve to spread the sails, the halyards, traces, lifts, clewlines, and all other ropes used in making, taking in, or manœuvring the sails.

The sails of a ship are square sails bent to the yards, and fore-and-aft sails traversing on stays or bent to gaffs. Let us describe an entire suit, beginning forward. On the extremity of the bowsprit is the flying-jib, a three-cornered sail, which goes from the end of its boom upward along its stay, leading to the fore-top-gallant-mast-head, and confined to the stay by rings of wood or iron, called *hanks*. The jib, which leads from its boom to the fore-top-mast-head, is of similar form, and so is the fore-top-mast-stay-sail, running from the bowsprit end towards the mast-head. On the fore-mast we have the fore-sail, bent to the fore-yard, and spread at the foot by means of tacks and sheets; above it, the fore-top-sail, bent to the top-sail-yard, by means of which it is hoisted aloft, while its lower corners are spread to the extremities of the fore-yard; next the top-gallant-sail, bent to its yard, and sheeting home to the top-sail-yard; and so with the royal and sky sail. Double top-sails and top-gallant-sails are now much in use, that is to say, these sails are practically made each into two sails, which gives greater ease in handling. All these sails are turned at pleasure, to be presented to the wind, by means of braces attached to their yard-arm, and leading to the main-mast. The main-mast is furnished with a similar suit of sails, somewhat larger; the mizzen, also, though smaller than either; instead of a square-sail on the lower mast, it has a gaff-sail, hoisting up and down abaft the mast. Some ships have similar gaff-sails on the fore and main masts, which are found of great use in gales of wind as a substitute for storm stay-sails. Most carry also light stay-sails between the masts; but they are very troublesome, and worse than useless. Studding-sails extended on special spars outside the square-sails when going large are very useful. The perfection of equipping a ship with spars, rigging, and sails, consists in so disposing them, that, in a whole-sail breeze, the centre of effort of all the sails will be in the same line with the ship's centre of rotation; or that the efforts of the forward and after sails to turn the ship will be so exactly balanced as not to require any continued assistance from the rudder in either direction; for this, while it impedes her progress, does not leave the entire force of the rudder disposable when necessary to turn. Of the two evils, however, seamen have more patience with a ship disposed to approach the wind than with one needing the continued action of the helm to keep her from falling off.

Our ship is now completely equipped, and ready to receive cargo. Those articles with which a ship may be filled full are stowed with a single view to economy of space. Some, as cotton, require ballast; others, as staves, or sugar and fluids, require none. When the articles are heavy and light, the heavier are placed nearest the bottom, to increase the ship's stability. When, however, all are heavy, there may be danger of making a ship too stiff; so that, not being balanced, she will roll violently, and, perchance, risk the fracture of a mast, or even spring a leak. To obviate this danger, the cargo should be raised: if iron, some should be stowed between decks; if coal or salt, it may be heaped up in the centre, taking care to secure it against shifting should the ship be knocked down by a sea or squall. Heavy articles should never be placed towards the extremities, lest they promote pitching. In all cases care must be taken to preserve the trim of the ship—that just proportion between her draught forward and aft which the estimate of the builder, or, when a voyage has been made, experience itself, has determined to be most favourable to rapid sailing. This

subject has been receiving special attention of late, and various methods of calculating the stability of ships, with graphic representations of such by curves, have been introduced, as the stability of ships, whether light or loaded, is a most important subject of public interest.

There is no difficulty in conceiving how a ship may be made to move freely before the wind with a velocity determined by the force of that wind, the quantity of sail exposed to it, and the adaptation of her form to divide the sustaining fluid with the least resistance. But a vessel can also sail with ease in directions other than directly before the wind, and even to approach it. Let us suppose that the wind, at first dead aft, gradually veers towards the side, until it blows at an angle of forty-five degrees with the keel. If, with the wind thus blowing, the sails are still kept braced perpendicularly to the keel, it must necessarily strike their surfaces obliquely, dividing itself into two forces, one passing off to leeward, the other exerting itself in the direction of the keel, and therefore tending to propel her forward. If, however, in order to expose the sails more fairly to the wind, they are braced forward until it becomes again perpendicular to their surfaces, the action of the wind on the sails is simple, but that of the sails on the ship is in turn compound, subdividing itself into two forces: one acting to drive her to leeward in a direction perpendicular to the keel, the other forward in a line with it. If, now, the ship were of a figure to move with equal freedom in any direction—round, for instance—it is evident that she would assume a mean motion between these two forces; but, being so formed as to divide the water with infinitely greater ease forwards than sideways, the force exerting itself perpendicularly to the keel is neutralized, whilst that in a line with it, encountering an inferior resistance, compels the vessel to advance. We will next suppose the wind to have drawn forward until perpendicular to the course. The sails, being trimmed forward, so as to keep full, are struck obliquely, and if the ship were again free to move in any direction, would impel her in a course perpendicular to their surface; but the portion of this force tending to drive the ship to leeward, being again encountered by the lateral pressure, is almost balanced; while, on the contrary, she freely obeys the force tending to propel her forward. Lastly, let us consider the situation of a ship when the wind gets before the beam, so as to make an angle of less than  $90^\circ$  with the course. It is evident, that, if she still continue to advance, it must be towards the wind: this seeming paradox of a vessel approaching the wind by the very effort of that wind to drive it away will still appear clear by the application of the same principles. To meet the emergency, let us now suppose the yards braced forward, until they make an angle of only  $30^\circ$  with the keel; the wind, being  $30^\circ$  farther aft, will make an angle of  $60^\circ$  with the keel. In this position the wind will strike obliquely on the after side of the sails; and though the greater part of the force passes off to leeward, there is still a partial effort to drive the sails in a direction perpendicular to their surface. This effort subdivides into two forces; one perpendicular to the keel, the other in a line with it: the first is nearly overcome by the lateral resistance; the second, encountering less, causes the ship to advance with a velocity proportioned to the smallness of the angle of incidence, and the disadvantageous application of the propelling power.

From what has been here stated it would seem that in theory the situation of the wind most favourable to propelling a ship is when it acts perpendicularly to the sails, and they in turn to the keel, that is, when dead aft. In gales of wind this is likewise

true in practice, but in moderate weather a ship will sail faster with the wind on the quarter, or even abeam, for then the sails do not mask each other, but all receive the wind without interruption. On this account our sharp schooners will sail nearly or quite as fast on a wind as off it, the sea being smooth and wind light, the form of the vessel being also an element in the speed of sailing off or on the wind. In square-rigged ships bracing the yards correctly is one of the nicest points of seamanship; in general the nearer the yards approach to allow of the sails receiving the pressure of the wind, consistently with keeping the sails full, the greater will be the velocity of the vessel on its course.

It may chance that the wind does not stop at the exact point which would enable the ship close-hauled barely to go her course, but even heads her off so far that she can no longer approach it nearer than a right angle. It is evident now that she is gaining nothing; but since she can sail within  $60^\circ$  of the wind by closing with it on the other side she may approach within  $30^\circ$  of the desired course. Hence it becomes essential to change sides. There are two ways of performing this evolution: the first consists in turning round towards the wind, and is called *tacking*; the second in turning before it, and is called *veering*. To tack, the crew are all stationed at the tacks, sheets, braces, and bowlines, ready to change the position of the sails. The ship being already close to the wind, the helm is gradually eased down, so that the rudder may not exert its full force until she begins to turn, nor act suddenly to check the headway, so essential to the success of the evolution; at the same time the head-sheets are flown, so as to cause the sails before the centre of rotation to shake and lose their power of balancing the after ones. As the ship approaches the wind the spanker is drawn gradually from the lee-side towards the centre, that it may keep full, and, by its action so near the stern, continue promoting the rotation. As soon as the sails reach the direction of the wind, and cease to draw, the corners of the courses are drawn up, and the tacks and sheets overhauled, ready to swing the yards. After a while the sails catch aback, and the fore-sails, soon masking the after ones, act with a powerful lever to turn the bow. At length, having come head to wind without loss of headway, and the evolution being certain, the after yards are swung round, ready to receive the wind on the opposite side, which operation is then more easily performed from the sails being becalmed by the fore ones. Lastly, when the after sails are filled by the wind, the head-yards are also braced round to receive its impulse, and the ship at once recovers headway. Should she gather sternway before the sails become full on the new tack, the helm is shifted, that its action in a backward direction, instead of checking, may aid the rotation. There may, however, be occasions in which it is impossible to tack, either because the wind is not of sufficient force, or else so strong as to render it dangerous; then veering is resorted to. To veer, the helm is put hard up, that is, brought close round to leeward of the stern-post, the spanker is brailled or hauled in, and the after sails shivered; in this situation the pressure of the head-sails, not being balanced by the after ones, tends, in conjunction with the rudder, forcibly to turn the ship. As she falls off the after-sails are still kept shivering until braced sharp on the opposite tack; when before the wind the spanker is set to aid the after-yards and helm in bringing her to; the fore-sails are then squared, and gradually braced forward until the ship be by the wind again.

A ship is easily manoeuvred in fine weather, but much skill and experience are required during a gale.

Let us suppose that whilst our ship is contending against a head wind, the misfortune is augmented by its gradual increase. Shortening sail becomes necessary, and is determined by two leading considerations, the stability of the ship and the strength of her masts: it is to diminish the careening of the one, and avoid endangering the other, that the surface spread to the wind is reduced. In shortening sail we always begin with the highest and lightest sails, descending gradually, and keeping pace in an inverse ratio with the increase of wind. The sails do not, however, come in uniformly in the direction of the length, but the after sails most rapidly, because, as the wind increases, the energy which it exerts in a forward direction upon the masts tends, with a powerful lever, to depress the bow and raise the stern; hence the latter drifts more easily to leeward, thereby bringing the bow towards the wind; this effort is also promoted by the action of the sails passing farther to leeward, and by the ship ceasing to sail on an even keel. From all these reasons the more the wind increases the more she tends to come to; so, to avoid a constant recurrence to the action of the rudder, it becomes necessary to shorten sail faster aft than forward, taking in the mizzen-top-gallant-sail, and even the spanker, before the fore and main top-gallant-sails; for the same reason, when it becomes necessary to reef, it is not unusual to begin with the mizzen-top-sail. Reefing consists in binding a portion of the sails to their respective yards, so as to reduce the surface. To reef the top-sails we clew the yards down, haul up the sides of the sails by means of reef-tackles, and brace the yards to the wind until the sails shiver and spill; then the men go out on the yard, and, by means of the earings and reef-points, securely bind the requisite portion. When the top-sails are double-reefed it is time for the jib to come in to relieve the jib-boom and fore-top-mast of the pressure: to counter-balance the loss of this head sail the mizzen-top-sail may be furled. When the top-sails are close-reefed the main-sail is either reefed or furled. As the gale increases furl the fore-top-sail, taking care to draw up the weather clew first, that the sail may not be in danger of shaking and blowing away. Our ship is now under reefed fore-sail, main-top-sail close-reefed, fore-top-mast-stay-sail, and storm stay-sails. These are stout triangular sails, running in the direction of the fore, main, and mizzen stays; they are often advantageously replaced by gaff-sails, which are similar to the spanker. Should it blow still harder it may be necessary to take in the fore-sail, replace the fore-top-mast by the storm stay-sail, and even furl the main-top-sail. The ship now drifts much, and, tending to fall off, from her greater draught abaft and consequent resistance of the water, will require the reefed spanker, and even the continued assistance of the rudder, to keep her to: the helm being kept constantly hard down, she is said to *lie to*. This is the way in which most ships make the best weather; some, however, tend so much to fall off into the trough of the sea as to be in perpetual risk of being boarded by the waves, and, if the hatches be not well secured, of having their existence fatally endangered. In this case it may become necessary to bear up and scud. To do this with least risk it is necessary to show the head of the fore-top-mast-stay-sail, or part of the fore-sail or fore-top-sail, taking advantage of a momentary lull and smoothness of the sea to bear away. The after sails are taken in on putting up the helm, and it may even be necessary to cut away the mizzen-mast. When before the wind sufficient sail must be spread to keep the ship before the waves, that they may not overtake and strike her with too much force; the main-

top-sail, from its height, is never becalmed by the sea, and is therefore a good sail to scud under. At such a season special care must be taken to provide for the security of guns, boats, and other movables liable to tear themselves loose; also that the pump-well be sounded at short intervals, to have timely notice of a leak.

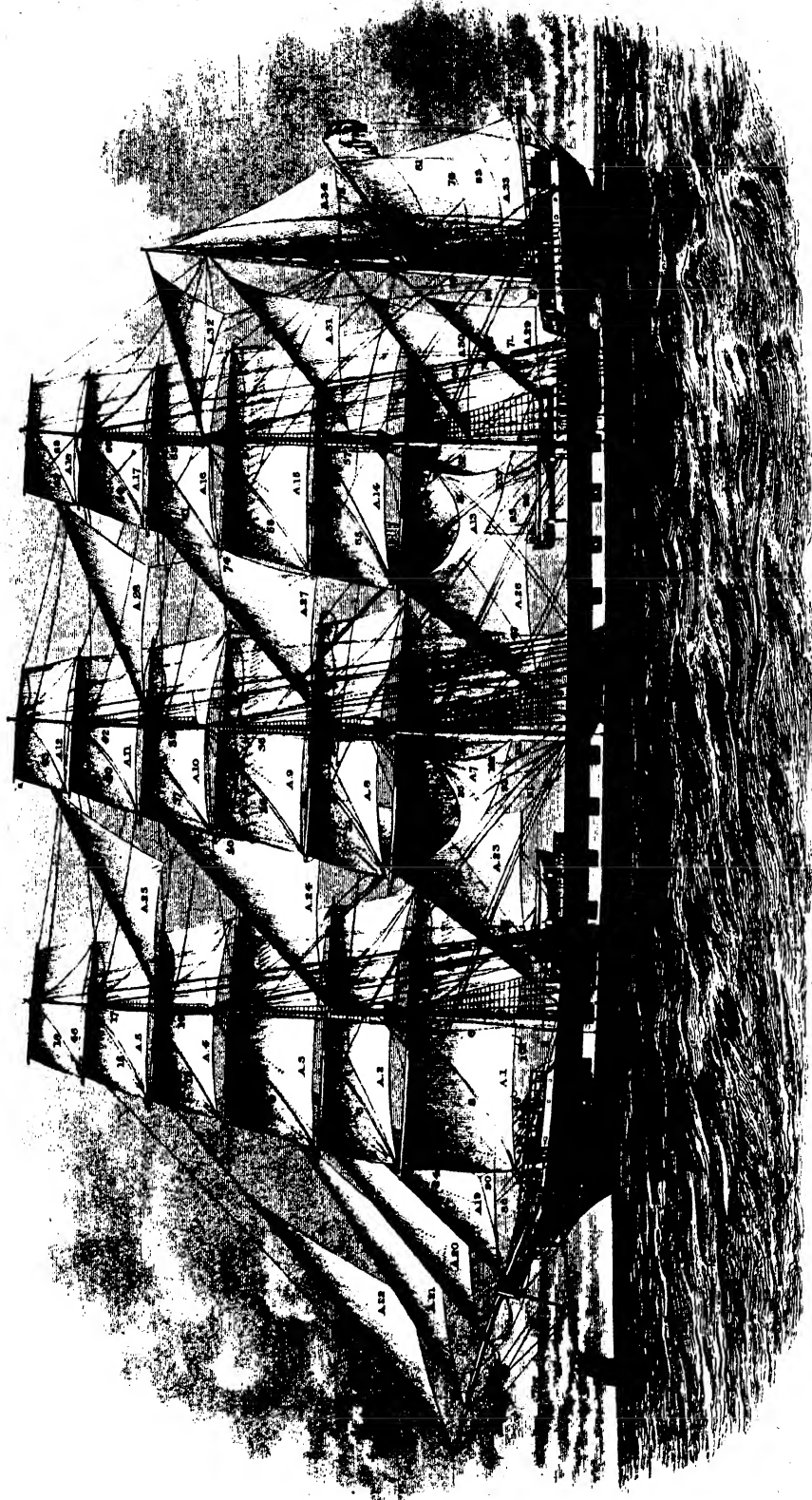
In order that the mariner may be able to conduct his vessel between two distant places he requires much more knowledge than merely enables him to take the fullest advantage of the wind or to handle his vessel in a gale. He must be acquainted with the science of navigation, and must therefore have an accurate knowledge of the figure of the earth, of the position of the imaginary lines drawn upon its surface for the purpose of marking position; he must know how to use the compass, the sextant, and the log; and must be provided with accurate charts of the seas in which his course lies. It is only by such means that he can discover the direction in which he sails and the distance he has gone, and can direct his vessel towards the point which he wishes to reach. The compass is the instrument by which the ship's course is determined, as it generally rests pointing in a northerly and southerly direction. (See COMPASS and COMPASS, MARINER'S.) It does not point usually to the true north, but has a certain variation or declination, as it is called (see DECLINATION), either to the east or to the west, which variation has to be taken into account in finding the ship's course. The deviation differs for different places, but it is usually known for any place, being marked on the charts, or it can be easily found astronomically. There is another variation to which the compass is subject, that due to the magnetism of the vessel itself. This is sometimes very considerable when the vessel is built of iron, or has a large quantity of iron on board. The difficulty caused by this variation may be got over, partially at least, in the way described in the article MAGNETISM (TERRESTRIAL). Very often a compass is fixed on a mast at some distance above the deck, and is compared with that on deck, the variation of the former being smaller. The rate of speed at which a vessel is moving is found by the log (see LOG), which is heaved usually at the end of every hour. By noting the rate of sailing, the direction of the course, and the time occupied, the ship's position may be estimated, allowance being made for deviation caused by currents, and by the wind driving the vessel to leeward. The position of a vessel determined by this means is said to be found by dead reckoning. It is not safe to trust to dead reckoning for any length of time, as it only gives the approximate place of the ship, since it is impossible to take into account deviation from the estimated course caused by unknown currents, defective steering, &c. A more exact means of finding the position of the vessel at any time is therefore required. For this purpose observations of the positions of the heavenly bodies are made with the sextant (which see), and these observations being compared with the data given in the Nautical Almanac, while the correct time is given by the chronometer, the latitude and longitude, that is, the true position of the vessel, can easily be found, as explained in the article LATITUDE and LONGITUDE.

In the technical phraseology of navigation the ship's *course* is the angle made with the meridians by the line on which she is sailing; her *departure* is the number of nautical miles she has sailed to the eastward or westward of her starting point; the *distance* is the length of the path she has sailed; the *difference of latitude* is the number of degrees, minutes, and seconds contained in an arc of the





ILLUSTRATIONS OF TERMS APPLIED TO THE SAILS, MASTS, AND RUNNING RIGGING.





meridian intercepted between the parallel of latitude from which the vessel started and that at which she has arrived; the *difference of longitude* is the length of an arc of the equator intercepted between the meridian started from and that arrived at. In working problems in navigation the difference of latitude, departure, and distance may be regarded as the sides of a right-angled triangle, as  $A, B, C$ , where  $AB$  is the difference of latitude,  $BC$  the departure, and  $AC$  the distance,  $BAC$  being consequently the course. By plane trigonometry, therefore, when any two of these four elements, namely, course, distance, difference of latitude, and departure, are given, the others can easily be found; or the result may easily be found by construction, with the aid of a rule and compasses. Such problems are solved also by Gunter's scale. Navigating a ship upon these suppositions is called *plane sailing*, because the surface of the earth is assumed to be an extended plane, the meridians being considered parallel lines, with the parallels of latitude running across them at right angles. The departure  $BC$  is assumed to be equal to the difference of longitude, but this, unless near the equator, is very far from correct, so that, unless the departure is one of the known elements, plane sailing will give false results. Low latitudes, therefore, where the meridians are nearly parallel, are best suited to plane sailing. *Parallel sailing* is when the ship sails on a parallel of latitude. In this case the departure is the same as the nautical distance, and only the longitude, not the latitude, is changed. When the ship sails on a rhumb-line, that is, obliquely across the meridians (see RHUMB-LINE), two other methods of sailing are employed, *middle-latitude sailing* or *Mercator's sailing*, but these we have not space to enter upon. *Great-circle sailing* is the method of sailing along a great circle of the earth (that is, one with its centre at the earth's centre). By this method the shortest course between two places is always traversed. It very often happens that a mariner cannot run his vessel in a straight line from one place to another, but, in consequence of intervening islands or mainland, must change his course several times, running so many miles or hundreds of miles in one direction, so many in another. Such an irregular track is called a *traverse*, and *traverse sailing* consists in reducing these several courses and distances run to a single course and distance. For this purpose a table is drawn out with six columns, in the first of which the courses (south-west, &c.) are put; in the second the distances; in the third and fourth, which are marked north and south, the differences of latitude either north or south, according as the course is in a northerly or a southerly direction; in the fifth and sixth the departures, which are either easterly or westerly. If we add together the quantities in the several columns, the difference between the sums in the north and south columns will give the true difference of latitude made good; while the difference between the sums in the east and west columns will give the departure made good. The course and distance made good can now be easily calculated.

Ships receive various names, according to their size, rigging, &c.; thus we have a ship, a barque, a brig, a schooner, a sloop, a lugger, and so on.

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As already stated many large sailing vessels have now four masts and some five, all square-rigged. The accompanying plates show the hull, spars, rigging, sails, &c., of a four-masted vessel, having the aftmost or jigger-mast barque-rigged (four-masted barque). All the names of the various parts will be found from the following lists

# PL. I.

## The Hull, Spars, and Standing Rigging.

### THE HULL.

- |                    |                      |
|--------------------|----------------------|
| 1 Head.            | 14. Cat-head.        |
| 2 Outwater.        | 15 Head-rails.       |
| 3 Bow              | 16 Capstan.          |
| 4 Forecastle-deck. | 17 Skylight.         |
| 5 Stern.           | 18 Light boards.     |
| 6 Rudder.          | 19 Foredeck-house.   |
| 7 Fore chains.     | 20 Life boats.       |
| 8 Main-chains.     | 21 Grog.             |
| 9. Mizzen chain.   | 22 Companion.        |
| 10. Bulwarks.      | 23 Skylight.         |
| 11 Poop deck       | 24 Wheel-box.        |
| 12 Ports           | 25 Poop rails.       |
| 13. Trail-boards.  | 26. Afterdeck-house. |

### THE SPARS.

- |                                |                                   |
|--------------------------------|-----------------------------------|
| 27. Bowspit.                   | 53. Main yard.                    |
| 28. Inner jib-boom.            | 54. Main lower topsail yard.      |
| 29. Outer jib-boom.            | 55. Main upper topsail yard.      |
| 30. Flying jib-boom.           | 56. Main lower topgallant yard.   |
| 31. Martingale.                | 57. Main upper topgallant yard.   |
| 32. Fore mast.                 | 58. Main-royal yard.              |
| 33. Fore-topmast.              | 59. Crowsjack yard.               |
| 34. Fore-topgallant mast       | 60. Mizzen lower topsail yard.    |
| 35. Fore-royal mast            | 61. Mizzen upper topsail yard.    |
| 36. Main-mast.                 | 62. Mizzen lower topgallant yard. |
| 37. Main topmast.              | 63. Mizzen upper topgallant yard. |
| 38. Main-topgallant mast       | 64. Mizzen-royal yard.            |
| 39. Main royal mast.           | 65. Jigger-gaff.                  |
| 40. Mizzen-mast.               | 66. Jigger boom.                  |
| 41. Mizzen-topmast.            | 67. Fore-top.                     |
| 42. Mizzen-topgallant mast.    | 68. Main top.                     |
| 43. Mizzen-royal mast          | 69. Mizzen top.                   |
| 44. Jigger mast                | 70. Jigger top.                   |
| 45. Jigger-topmast.            | 71. Fore doubling.                |
| 46. Jigger topgallant mast     | 72. Fore-mast cap.                |
| 47. Fore yard.                 | 73. Fore topmast cross trees.     |
| 48. Fore lower topsail yard    | 74. Fore topmast cap.             |
| 49. Fore upper topsail yard    | 75. Ensign                        |
| 50. Fore lower topgallant yard | 76. Company's flag.               |
| 51. Fore upper topgallant yard |                                   |
| 52. Fore-royal yard            |                                   |

### THE STANDING RIGGING.

- |                                   |                                     |
|-----------------------------------|-------------------------------------|
| A 1 Bobstay.                      | A 31. Main-topgallant back-stays.   |
| A 2. Bowspit shroud.              | A 32. Main-royal back stays.        |
| A 3. Martingale-stay.             | A 33. Main-lift.                    |
| A 4. Jib boom guys.               | A 34. Main-top-sail lift.           |
| A 5. Fore stays                   | A 35. Main-topgallant lift.         |
| A 6. Fore-topmast stays.          | A 36. Main-royal lift.              |
| A 7. Inner-jib stay.              | A 37. Mizzen-stays.                 |
| A 8. Outer-jib stay.              | A 38. Mizzen topmast stays.         |
| A 9. Flying-jib stay.             | A 39. Mizzen topgallant stay.       |
| A 10. Fore-royal stay.            | A 40. Mizzen royal stay.            |
| A 11. Fore-rigging.               | A 41. Mizzen-rigging.               |
| A 12. Fore-topmast rigging.       | A 42. Mizzen-topmast rigging.       |
| A 13. Fore topgallant rigging.    | A 43. Mizzen-topgallant rigging.    |
| A 14. Fore-cap back-stay.         | A 44. Mizzen-cap back-stay.         |
| A 15. Fore-topmast back-stays.    | A 45. Mizzen-topmast back-stays.    |
| A 16. Fore-topgallant back-stays. | A 46. Mizzen topgallant back-stays. |
| A 17. Fore-royal back-stay.       | A 47. Mizzen-royal back-stays.      |
| A 18. Fore-lift.                  | A 48. Crowsjack lift.               |
| A 19. Fore-top-sail lift.         | A 49. Mizzen top-sail lift.         |
| A 20. Fore-topgallant lift.       | A 50. Mizzen-topgallant lift.       |
| A 21. Fore-royal lift.            | A 51. Mizzen-royal lift.            |
| A 22. Main stays                  | A 52. Jigger-stays.                 |
| A 23. Main-topmast stays          | A 53. Jigger middle stay.           |
| A 24. Main-topgallant stays.      | A 54. Jigger-topmast stay.          |
| A 25. Main royal stays.           | A 55. Jigger-topgallant stay.       |
| A 26. Main-rigging.               | A 56. Jigger-rigging.               |
| A 27. Main-topmast rigging.       | A 57. Jigger-topmast rigging.       |
| A 28. Main-topgallant rigging.    | A 58. Jigger-topmast back-stays.    |
| A 29. Main-cap back-stay.         | A 59. Jigger-topgallant back-stays. |
| A 30. Main topmast back-stays.    |                                     |

## Pl. II.

*The Sails and Running Rigging.*

## THE SAILS.

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| ▲ 1. Fore-sail.                     | ▲ 18. Mizzen-royal.                |
| ▲ 2. Fore lower topsail.            | ▲ 19. Fore-topmast stay-sail.      |
| ▲ 3. Fore upper topsail.            | ▲ 20. Inner-jib.                   |
| ▲ 4. Fore lower topgallant sail.    | ▲ 21. Outer-jib.                   |
| ▲ 5. Fore upper topgallant sail.    | ▲ 22. Flying-jib.                  |
| ▲ 6. Fore-royal.                    | ▲ 23. Main-topmast stay-sail.      |
| ▲ 7. Main-sail.                     | ▲ 24. Main-topgallant stay-sail.   |
| ▲ 8. Main lower topsail.            | ▲ 25. Main-royal stay-sail.        |
| ▲ 9. Main upper topsail.            | ▲ 26. Mizzen-topmast stay-sail.    |
| ▲ 10. Main lower topgallant sail.   | ▲ 27. Mizzen-topgallant stay-sail. |
| ▲ 11. Main upper topgallant sail.   | ▲ 28. Mizzen-royal stay-sail.      |
| ▲ 12. Main-royal.                   | ▲ 29. Jigger stay-sail.            |
| ▲ 13. Crossjack.                    | ▲ 30. Jigger middle stay-sail.     |
| ▲ 14. Mizzen lower topsail.         | ▲ 31. Jigger-topmast stay-sail.    |
| ▲ 15. Mizzen upper topsail.         | ▲ 32. Jigger-topgallant stay-sail. |
| ▲ 16. Mizzen lower topgallant sail. | ▲ 33. Jigger.                      |
| ▲ 17. Mizzen upper topgallant sail. | ▲ 34. Gaff topsail.                |

## THE RUNNING RIGGING.

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|---------------------------------------|---|
| 1. Fore-tack.                         | 50. Main-topmast reef-tackles.          |
| 2. Fore-sheet.                        | 51. Crossjack tack.                     |
| 3. Fore clew-garnet.                  | 52. Crossjack sheet.                    |
| 4. Fore-braces.                       | 53. Crossjack clew-garnet.              |
| 5. Fore lower topsail sheet.          | 54. Crossjack braces.                   |
| 6. Fore lower topsail clew-lines.     | 55. Mizzen lower topsail clew-lines.    |
| 7. Fore lower topsail braces.         | 56. Mizzen lower topsail braces.        |
| 8. Fore upper topsail sheets.         | 57. Mizzen upper topsail sheet.         |
| 9. Fore upper topsail clew-lines.     | 58. Mizzen upper topsail clew-lines.    |
| 10. Fore upper topsail braces.        | 59. Mizzen upper topsail braces.        |
| 11. Fore lower topgallant sheet.      | 60. Mizzen lower topgallant sheet.      |
| 12. Fore lower topgallant clew-lines. | 61. Mizzen lower topgallant clew-lines. |
| 13. Fore lower topgallant braces.     | 62. Mizzen lower topgallant braces.     |
| 14. Fore upper topgallant sheet.      | 63. Mizzen upper topgallant sheet.      |
| 15. Fore upper topgallant clew-lines. | 64. Mizzen upper topgallant clew-lines. |
| 16. Fore upper topgallant braces.     | 65. Mizzen upper topgallant braces.     |
| 17. Fore-royal sheet.                 | 66. Mizzen-royal sheet.                 |
| 18. Fore-royal clew-lines.            | 67. Mizzen-royal clew-lines.            |
| 19. Fore-royal braces.                | 68. Mizzen-royal braces.                |
| 20. Fore-topmast halyards.            | 69. Mizzen-topmast halyards.            |
| 21. Fore-topgallant halyards.         | 70. Mizzen-topgallant halyards.         |
| 22. Fore-royal halyards.              | 71. Mizzen-royal halyards.              |
| 23. Fore-signal halyards.             | 72. Mizzen-signal halyards.             |
| 24. Fore reef-tackles.                | 73. Crossjack reef-tackles.             |
| 25. Fore-topmast reef-tackles.        | 74. Mizzen-topmast reef-tackles.        |
| 26. Main-tack.                        | 75. Jigger peak-halyards.               |
| 27. Main-sheet.                       | 76. Jigger brails.                      |
| 28. Main clew-garnet.                 | 77. Jigger gaff-topmast sheet.          |
| 29. Main-brace.                       | 78. Ensign halyards.                    |
| 30. Main lower topsail sheet.         | 79. British ensign.                     |
| 31. Main lower topsail clew-lines.    | 80. Gaff-topmast halyards.              |
| 32. Main lower topsail brace.         | 81. Vangs or Vances.                    |
| 33. Main upper topsail sheet.         | 82. Jigger outhaul.                     |
| 34. Main upper topsail clew-lines.    | 83. Boom topping lift.                  |
| 35. Main upper topsail braces.        | 84. Boom guys.                          |
| 36. Main lower topgallant sheet.      | 85. Boom sheet.                         |
| 37. Main lower topgallant clew-lines. | 86. Flying-jib sheet.                   |
| 38. Main lower topgallant braces.     | 87. Outer-jib sheet.                    |
| 39. Main upper topgallant sheet.      | 88. Inner-jib sheet.                    |
| 40. Main upper topgallant clew-lines. | 89. Fore-topmast stay-sail sheet.       |
| 41. Main upper topgallant braces.     | 90. Fore-bowline.                       |
| 42. Main-royal sheet.                 | 91. Main-topmast stay-sail sheet.       |
| 43. Main-royal clew-lines.            | 92. Main-topgallant stay-sail sheet.    |
| 44. Main royal braces.                | 93. Main-royal stay-sail sheet.         |
| 45. Main-topmast halyards.            | 94. Mizzen-topmast stay-sail sheet.     |
| 46. Main-topgallant halyards.         | 95. Mizzen-topgallant stay-sail sheet.  |
| 47. Main royal halyards.              | 96. Mizzen-royal stay-sail sheet.       |
| 48. Main signal-halyards.             | 97. Jigger stay-sail sheet.             |
| 49. Main reef-tackles.                |   |

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| 98. Jigger-topmast stay-sail sheet.    | 100. Reef points.         |
| 99. Jigger-topgallant stay-sail sheet. | 101. Fore-buntlines.      |
|  | 102. Main-buntlines.      |
|  | 103. Crossjack buntlines. |

In the plate illustrating the article WAR-VESSELS several representations of the modern types of war-vessels are given.

## SHIP-BROKER. See INSURANCE.

SHIP-MONEY, an impost levied at various times in England for the purpose of furnishing ships for the king's service. In early times the seaports, and even maritime counties of England, and occasionally also inland places, were sometimes called upon to furnish ships for the public service. This was the case in 1007, when an invasion of the Danes was imminent, and again at the time of the approach of the great Spanish Armada. Elizabeth required the various ports to furnish a certain number of ships at their own expense. But the special tax to which the denomination of ship-money has been applied is that imposed by Charles I. In the first writs issued by Charles in reference to this matter (October, 1634) he directed the magistrates of London and other seaport towns to provide a certain number of ships of war of a prescribed tonnage and equipage, empowering them at the same time to assess all the inhabitants according to their substance for a contribution towards this armament. The alleged reason for this step was the depredations of pirates in British waters and threatened dangers from the Continent. The impost, especially since it was imposed by the king's own arbitrary authority, awakened much murmuring on the part of the people, and this in certain cases manifested itself in a refusal to submit to pay it. Charles, however, not only forced compliance, but issued new writs by which the tax, now more properly called ship-money, was made to assume a still more objectionable form, being extended to the whole kingdom; and while the former writs had only demanded the actual equipment of vessels, the sheriffs were now directed to assess every landholder and other inhabitant according to their judgment of his means, and to enforce the payment by distress. This extraordinary demand startled even those who had hitherto sided with the court, but all opposition was overborne in the high-handed manner characteristic of all the dealings of Charles I. with his subjects. In 1637, however, the celebrated John Hampden resolved to question the legality of this exercise of the king's prerogative, and refused to pay. For this refusal he was prosecuted in the Exchequer Chamber. After lengthened arguments adduced on both sides, the trial, which had been watched with great interest by the whole nation by reason of the important question involved, was brought to a close by a decision in favour of the crown. From this finding of the court four out of the twelve judges dissented. This of course put an end for the time to all attempts at obtaining redress by course of law. But shortly after the meeting of the Long Parliament, in 1640, it voted ship-money illegal, and reversed the sentence passed against Hampden.

## SHIP OF FOOLS. See BRANDT.

SHIP-OWNERS, LAW REGARDING. The ownership of any vessel determines its claim to be classed as a British ship, for in order to be so classed the owners must either be natural-born British subjects who have not taken an oath of allegiance to a foreign state; or, secondly, persons made denizens or naturalized by Parliament; or, finally, bodies corporate, having their principal place of business in the United Kingdom or some British possession. The liability of the owner of a sea-going ship to make good any loss or damage that may happen without his actual

fault or privity is not allowed in the following cases: When it happens (1) to any goods whatsoever taken in or put on board any such ship by reason of any fire occurring therein; (2) to any gold, silver, diamonds, watches, jewels, or precious stones taken in or put on board any such ship by reason of any robbery, embezzlement, making away with or secreting thereof, unless the owner or shipper had, at the time of shipping the same, inserted in his bills of lading, or otherwise declared in writing to the master or owner of such ship, the true nature and value of such articles. His liability is expressly limited by 25 and 26 Vic. c. 63 to a certain amount per ton of the ship's tonnage where certain events occur without his actual fault or privity:—Where any loss of life or personal injury is caused to any person being carried in such ship; where any damage or loss is caused to any goods, merchandise, &c., on board any such ship; where any loss of life or personal injury is, by reason of the improper navigation of such ship, caused to any person carried in any other ship or boat, or damage is caused similarly to goods on board any other ship or boat. Any person sending an unseaworthy ship to sea is guilty of a misdemeanour unless he can prove that he made use of all reasonable means to insure that the ship should be seaworthy. Acts have been passed increasing the power of the board of trade to stop outgoing unseaworthy ships, and making it obligatory for a vessel before starting for a voyage to have the load-line distinctly marked; grain cargoes to be carried in bags.

**SHIPS, REGISTRATION OF.** No vessel is entitled to the privileges of a British ship unless registered by the collector and comptroller of the customs, and unregistered ships exercising the privileges of registered ones are to be forfeited. A ship may not be described by any other name than that by which she is for the time being registered, and application for permission to change the name must be made in writing to the board of trade. The name must be painted on the stern in white or yellow letters 4 inches long, upon a black ground, under a penalty of £100.

**SHIP-WORM** (*Teredo navalis*), the popular name of a Lamellibranchiate Mollusc belonging to the Pholadidae or Pholus family, and distinguished by the elongation of the respiratory 'siphons' or breathing-tubes conveying water to the gills, which give to this mollusc a somewhat vermiform or worm-like aspect. The two valves or halves of the shell are of small size and globular shape, and are situated at its anterior extremity. The valves are three-lobed, and have each a transverse furrow. The foot-opening is of small size. The bulk of the viscera and body are contained within the valves; and the gills are long, and pass into the elongated siphons. The orifices of the siphons—one inhalant and one exhalant—are fringed. In length the ship-worm averages about a foot, and in thickness about  $\frac{1}{4}$  inch.

This animal has gained great notoriety from its boring habits, and is regarded with great interest by all concerned in the construction or preservation of marine works. Like other Pholadidae, the *Teredo* is an expert borer, and excavates burrows in wood; sometimes attacking the timbers of piers and vessels in immense numbers, and riddling them to such an extent that they are rendered utterly useless, and are in time completely destroyed. The shell is the instrument by means of which this otherwise insignificant mollusc becomes converted into an object of terror to man. It inhabits most seas, and undoubtedly does good service in warm latitudes by destroying the floating masses of timber brought down by the large river systems of the world. Linnaeus long ago styled the *Teredo calamitas narium*—

the 'calamity or scourge of ships'—and it has even appeared in some instances as the threatened destroyer of a whole nation. In 1781–82 the United Provinces were put on the alert by the discovery that the *Teredo* was hard at work on the wooden piles which support the 'dykes' of Zealand and Friesland, and which, in fact, keep the sea from overwhelming these provinces. Great rewards were offered by the government, and the invention of lotions, paints, and varnishes exercised the ingenuity of chemists; but all proved fruitless to arrest the Ship-worm's ravages, and in a few years it ultimately abandoned the piles of its own accord. In Plymouth dockyard the hardest oak has been repeatedly seen to be riddled through and through by the *Teredo* in a comparatively short time. The plan which appears to have been most successful in arresting the ravages of the Ship-worm is that of driving a number of short nails with large heads into the exposed timber. As the rust from the heads of the nails extends across the wood it appears to prevent the operations of the *Teredo*. Rust, in fact, appears baneful to this mollusc, as also does corrosive sublimate, which is said by M. De Quatrefages to prove very fatal to it, even in excessively minute doses. This latter, however, is a plan of less practicable kind than the simpler one dependent on the noxious action of rust. Salts of lead and copper are said also to operate effectively in destroying the *Teredo*; but like the corrosive sublimate remedy these preparations cannot be effectively applied to timber so as thoroughly and permanently to insure its immunity from the attack of the Ship-worm. In its young or embryonic state the *Teredo*, like other lamellibranchiates, exists in a free-swimming and actively-locomotive condition; the embryo being provided with vibratile cilia, and afterwards with a foot-like organ, as well as with organs of sight and hearing.

A large species of *Teredo* (*T. gigantea*), from Sumatra, has also been described. Specimens of it have been found to measure from 4 to 6 feet, and to have a diameter of about 8 inches. It bores into the solid mud, and does not appear to destroy timber like its smaller neighbour. The common *Teredo*, in boring, lines its burrow with a limy coat. Sir I. Brunel is said to have obtained his idea of forming the Thames Tunnel from the mode of burrowing of the Ship-worm.

**SHIRAZ**, a town of Persia, in the province of Fars, on a large and beautiful plain, 220 miles s.s.w. of Ispahan. It was almost entirely destroyed by an earthquake in May, 1853, when about 12,000 of its inhabitants perished. The city has been partially rebuilt in a somewhat inferior style, and being advantageously situated on the routes from the port of Bushire to Kerman, Yezd, and Ispahan, is the centre of a very extensive trade, though it does not possess the splendour and importance of early times. It has considerable manufactures of silk and cotton goods, fire-arms, sword-cutlery, glass, earthenware, &c. Its lapidaries and enamellers are celebrated throughout Persia. Its vicinity exhibits the remains of many magnificent buildings, and about 25 miles n.n.e. are the famous ruins of Persepolis. Hafs and Sadi were both natives of Shiraz. Pop. 80,000.

**SHIRE** (from Anglo-Saxon *sciran*, to divide), the name applied to the larger divisions into which Great Britain is divided, and practically corresponding to the term county, by which it is in many cases superseded. The exact time at which the division of England into shires was made is uncertain, but that there was some such division even earlier than the time of Alfred, to whom it has been sometimes attributed, appears indubitable. It has been shown that in many cases the shires are identical with the

old Saxon states; such are Kent, Sussex, Essex, Middlesex, Surrey, Norfolk, and Suffolk. Lincolnshire was likewise an independent state, though under a different name, Lindsey; and as early as 800 the Kingdom of the Hwiccas, afterwards Worcester, formed a district or shire, governed by an ealdorman, under the King of Mercia. Other kingdoms were for convenience divided into several shires, and some shires which once had a separate existence have been merged into others, as Northamptonshire, Islandshire, Hexhamshire, Winchilcombeshire, Craikshire, and others. The head—civil, military, and judicial—of the shire was the ealdorman (earl). In the shire-mote, which was held twice a year, his jurisdiction was divided with the bishop. Scotland followed the example of England as regards the division of the country into shires. Twenty-five shires are enumerated in a public ordinance of 1305. That shire and county do not seem to be quite identical would appear from the circumstance that in the case of some counties the termination shire is never added to the name; but this may have arisen from purely accidental causes. In Scotland Kirkcudbright is neither a county nor a shire, but a stewartry (see STEWARTRY), and in England there were at one time three counties palatine. (See COUNTY PALATINE.) The shires in England were subdivided into *hundreds*, and these again into *tithings*; in Scotland they were subdivided into *wards* and *quarters*. See COUNTY.

SHIRÉ, a river of South-eastern Africa, draining Lake Nyassa into the Zambesi, which it enters on its left bank in lat. 17° 46' S.; lon. 35° 35' E., after a course of about 270 miles in a southerly direction. It is navigable throughout its entire length, with the exception of about 30 miles of rapids occurring about midway in its course, and flows through a fine cotton and grain growing country. Above the cataracts the Shiré is a broad deep stream, but a good part of its course is shallow. It is becoming an important trade route, and there are now British settlements and plantations in the Shiré country (as at Blantyre and Zomba). See NYASSA.

SHIRLEY, JAMES, a poet and dramatic writer, was born in London on Sept. 18, 1596, educated at Merchant Taylors' School, and thence removed to St. John's College, Oxford. He subsequently went to Cambridge. Having taken holy orders, he obtained a curacy near St. Albans. He soon after went over to the Church of Rome, and, giving up his curacy, became master of the grammar-school in the same town. In or before 1625 he removed to London, became a writer for the stage, and acquired a reputation which caused him to be taken into the service of Queen Henrietta Maria. His first comedy was licensed in 1625, and from that date he produced many plays in rapid succession. In 1636 he went to Ireland. He returned four years later, and when the civil war broke out he left London with his wife and family, and being invited by the Earl of Newcastle, he accompanied that nobleman to the wars. On the decline of the king's cause he returned to London, and, the acting of plays being prohibited, resumed teaching. In 1666 he was forced, with his wife, by the great fire, from his house in St. Giles parish; and being extremely affected by the loss and terror that the fire occasioned, they both died, October 29, within twenty-four hours of each other. Besides thirty-seven tragedies and comedies, he published a volume of poems. His best dramas are the tragedies, *The Traitor*, *The Royal Master*, and *The Cardinal*; and the comedies, *Hyde Park*, *The Ball*, *The Gamester*, and *The Imposture*. The best edition of his dramatic works is that by Gifford and Dyce (1833). Shirley was the last of the great writers who belong to the school of Shakspeare.

SHIRWA, a lake in South-east Africa, lying south-east from the south end of Lake Nyassa; and mainly in territory that now belongs to Britain. It is of an oval shape, tapering to the south; its length is 60 miles, and the breadth 20 miles. The height above the sea is 1800 feet. The country around is very beautiful, and clothed with rich vegetation. Exceedingly lofty mountains, perhaps 8000 feet above sea-level, stand near the eastern shore; on the west stands Mount Zomba, 7000 feet in height and 20 miles long. Several small rivers enter the lake on the south and west, but it has no outlet.

SHISDRA, a town of Russia, in the government of Kaluga, 80 miles south-west of Kaluga, on the northern shore of a lake formed by a river of the same name. It has iron and glass works, and manufactures of woollen cloth. Pop. (1893), 12,099.

SHISHAK, or SESAC, an Egyptian king, mentioned by the Hebrew writers, the Sheshenk I. of the monuments, and the first sovereign of the Bubastite twenty-second dynasty. His name occurs in connection with two events in the Old Testament. It was he to whom Jeroboam fled for protection when he fell under the suspicion of Solomon (1 Kings xi. 40); and in the fifth year of Rehoboam he invaded Judah. Little opposition seems to have been made on the part of Judah, whose fenced cities he took one after another until he arrived at Jerusalem, which, according to the statement of Josephus, fell without a struggle. (Compare 2 Chron. xii. 1-10.) Shishak does not seem to have used any severity towards the inhabitants, but he pillaged the temple and the king's palace, carrying off the rich treasures accumulated in the reigns of Solomon and David, and reduced Judah to the position of a tributary kingdom. From the data furnished by the monuments it is inferred that he ascended the throne of Egypt about 980 B.C., a date which will allow of his reign coinciding with that of Rehoboam. In a narrow passage sculptured on the wall of the great Temple of Karnak, in Upper Egypt, is a record of the conquests of Shishak and of the countries ruled by him. On this is a row of sixty-three prisoners, presented by the agency of the god Ameeura to Shishak. Each figure has his arms tied behind him, and a rope round his neck. He is placed upon a turretted oval, indicative of a walled city, within which is the name of Judah. In the lists of his conquests during the expedition in which Judah was subjected to his rule we find the names of cities in both the Kingdoms of Israel and Judah, and of several Arabian tribes to the south of Palestine. Amongst those of the cities which can be recognized in these lists are Rabboth, Taanach, Sunem, Rehob, Hapharaim, Adoraim, Mahanaim, Gibeon, Beth-Horon, Kedemoth, Ajalon, Megiddo, and Judah Maluk, 'the royal city of Judah,' or Jerusalem. Shishak appears to have been one of the ablest and most powerful of the Egyptian monarchs. All Egypt was under his sway. Libya also, as well as the Sukkims and the Ethiopians, and no inconsiderable portion of Asia bordering on Egypt, were subject to him. His reign lasted twenty-one years at least, but how much longer it continued is uncertain.

SHOA, an important province lying in the south-east of the kingdom of Abyssinia, with ill-defined boundaries. It consists of a series of plateaux at 3000 feet above sea-level, and traversed by mountain chains, which, in the culminating point, Mount Metatite, near Ankobar, are said to have a height of 10,723 feet. Its east portion, called Eflat, has a less elevated and more generally sloping surface, which is highly cultivated, and yields good crops of grain, chiefly wheat and barley. Cotton also is extensively cultivated. The higher plateaux are

devoted to pasture. Among the trees peculiar to Shoa is the *Juniperus excelsa*, which in the course of a century attains a height of 160 feet, with a diameter at the base of 4 to 5 feet. The exports of the province itself comprise grain and large quantities of a durable cotton cloth, and to these may be added, as articles of trade, coffee, gold-dust, ivory, gums and spices, ostrich-feathers, hides, dye-woods, medicinal plants, &c. Christianity was introduced as early as the third century, and is still professed by a large number of the inhabitants, though in a very degenerate form. Pop. estimated at 2,500,000, of whom about 1,000,000 are Christians, and the rest chiefly Mohammedans. The present capital is Adis Ababa, but the chief town is Ankobar.

**SHOCK**, in medicine, a sudden depression of organic, nervous, or vital power, frequently attended with more or less perturbation of body and mind, occasioned either by bodily injury of a peculiar nature, or by an overwhelming moral calamity. It results either in a complete suspension of the action of the heart, causing death, or passes into reaction. In its less severe forms the vital powers react sooner or later, and after a time resume their normal functions; while in its worse forms the vital sinking increases with greater or less celerity, and extends from the organs more strictly vital to all other parts, until death ensues. The severity of a shock, no less than the phenomena it manifests, is considerably modified by the constitution and temperament and also the state of health of the person affected. Thus a person of a powerful constitution is much less affected by it than a delicate or nervous individual. In the state of collapse consequent upon a shock the patient lies completely prostrate, the face pale and bloodless, the skin cold and clammy, and the features contracted and expressive of great languor. There is also extreme muscular debility, and the pulse is frequently so weak as scarcely to be perceptible. Incoherency, drowsiness, or complete insensibility, is often manifested on the part of the patient. In cases of slight shock little or no treatment is required, but in severe cases the treatment is of great importance. The two objects to be sought are the restoration of the warmth of the body and of the activity of the circulation. Both of these objects are attained by the same treatment. The person is to be laid on a bed or couch and the clothes are to be quickly removed, the usual night garments being substituted. Hot-water bottles should be placed at the feet, or hot bricks wrapped up in flannel. If the coldness of the body is extreme and the prostration great, the patient may be wholly wrapped in warm blankets, and hot-water bottles placed outside the blankets to maintain their warmth. Mustard poultices may also be applied. Meanwhile the limbs should be rubbed from their extremity upwards, but without exposing to further cold. Stimulants are to be given by the mouth if the person can swallow. Whisky or brandy in hot water is the best, but strong hot coffee or tea is useful, and weak spirit of hartshorn may also prove of service. If the person cannot swallow, the stimulant should be injected into the bowel. Sulphuric ether is often employed to produce a rally in profound prostration after injury or loss of blood; it is injected by means of the hypodermic syringe. Not all of these measures are necessary save in the most extreme cases. Relapses should be guarded against.

**SHODDY.** See WOOLLEN MANUFACTURE.

**SHOEING OF HORSES.** The shoeing of horses does not appear to be a very ancient practice. It was not employed by the Greeks and Romans, though the latter did sometimes protect the feet of their horses by shoes of a kind. The first iron shoe

fastened to the foot with nails is said to have been discovered in the tomb of Childeric, king of the Franks, who died in 481. It is therefore probable that the invention of horse-shoes properly so called is to be attributed to some of the barbarous peoples that overturned the Roman Empire, and this probability is increased by the fact that the last Byzantine writers on veterinary science who lived in the fourth century make no mention of the art of horse-shoeing. In the tenth century the art is expressly mentioned in the Military Tactics of the Emperor Leo VI., and in the next century it must have been of great importance in armies, judging from the remuneration attached to it in the army of William the Conqueror, for we find it stated that William gave to Simon Saint-Liz the town of Northampton and the district of Falkley, on condition of providing shoes for his horses. Henry de Ferrers, another of William's followers, ancestor of the Earls Ferrers, received his name from his post of superintendent of the horse-shoers or farriers (*ferriers* in old French, from Latin *ferrum*, iron). Horse-shoes do not appear to have been known in England before this time. The ordinary form of horse-shoe is well known, but there are many different shapes employed in particular cases. There is an American machine for making horse-shoes which turns them out at the rate of sixty a minute, more than two men can forge in a day.

**SHOES AND SHOEMAKING.** When coverings for the feet first began to be used cannot of course be precisely stated; but there can scarcely be any doubt that they would have been among the earliest articles of dress worn, considering the necessity for their use. The first allusion to a shoe in the Old Testament is where Abraham refuses to take so much as a 'shoe-latchet' from the King of Sodom (Gen. xiv. 23). The shoe of the Hebrews was generally a sandal. There is no actual description of it, however, to be found in Scripture, but the rabbis inform us that the materials employed in its construction were either leather, felt, cloth, or wood, and that they were occasionally shod with iron. Sometimes they were beautifully ornamented (Cant. vii. 1). In Egypt, according to Herodotus, various substances, such as palm-leaves and papyrus stalks, were used in making sandals in addition to leather; while in Assyria wood or leather was employed (Layard, Nineveh, ii. 323), and both the heel and the side of the foot were encased. Shoes proper, as well as sandals, seem to have been used amongst the Jews; for on the black obelisk from Nimroud Jews are represented as wearing shoes or boots with turned-up toes, similar to those worn by orientals in the present day. The Romans used various kinds of shoes, such as the *solea* or sandal; the *calceus*, which covered the whole foot, somewhat like our shoes, and was tied with a latchet or lace; and the *caliga*, a very strong kind of shoe, sometimes shod with nails, worn by the soldiers, who were thence called *caligati*. The shoes worn by the comedians were *sorci*, slippers, and those of the tragedians *cothurni*.

Various symbolical usages are alluded to in Scripture in connection with the shoe. Thus in transferring a possession or domain it was customary to deliver a shoe, as in the middle ages a glove; hence the action of throwing down the shoe upon a region or territory implied occupancy, as—'Over Edom will I cast out my shoe' (Ps. lx. 8; cviii. 9). So in Ruth iv. 7, 8, the delivery of a shoe showed that the next of kin gave up a sacred obligation. (Comp. Lev. xxv. 9.) It has always been a mark of reverence in the East to lay aside the shoes on approaching any sacred spot (for example, Ex. iii. 5; Jos. v. 15). Latterly in the temple service the priests officiated

barefoot. To carry or unloose a person's sandal was a menial office, betokening great inferiority on the part of the person performing it. Hence the significance of John's utterance, Mat. iii. 11.

Both in ancient and in modern times the fashion of shoes has varied much, just as in other articles of dress. Thus we find that 'those of the Greeks and Romans who wore shoes, including generally all persons except youths, slaves, and ascetics, consulted their convenience and indulged their fancy by inventing the greatest possible variety in the forms, colours, and materials of their shoes.' High shoes, reaching nearly to the middle of the legs, were used in England as early as the tenth century. At one time, as in the reigns of Henry I. and Stephen, we meet with 'peaked-toed boots and shoes of an absurd shape.' The long points were sometimes stuffed with tow, and made to curl in the form of a ram's horn. In the reign of Richard II. the points had increased to such an extent that they reached the knee, to which they were secured by chains of silver or gold. Long toes being prohibited by act of Parliament in 1463, wide toes came next into fashion, and to such a height did it go that in the reign of Mary it was found necessary to limit the width by royal proclamation to 6 inches. At another time, as in the eighteenth century, absurdly high-heeled shoes were the rage among the ladies, a fashion revived in later times. The courtiers of Louis XIV. were remarkable for their extravagant boots; their tops were enormously large and wide, and decorated with a profusion of costly lace. This fashion was subsequently introduced into England. The present simple form of shoe was adopted in the early part of the seventeenth century, and somewhat later the shoe buckle came into use. Shoes worn by ladies in the eighteenth century were sometimes very elaborate and costly, made of bright-coloured silk, ornamented with gold or silver stars and a different colour of silk binding. In the early part of the nineteenth century buckles became unfashionable, their place being supplied by the simpler and less costly shoe-strings. To the same period belongs another improvement in shoemaking, the making of shoes right and left.

Until a comparatively recent date the manufacture of shoes was almost wholly a handicraft employment, and was usually engaged in by individuals in the isolation of their own dwellings. The introduction of machinery, and particularly of the sewing-machine, has completely revolutionized the industry. The manufacture is now carried on in large factories, where the principle of division of labour is worked out to its fullest extent. Each workman attends only to a single process in the making of a shoe, and nearly all the workmen are mainly occupied in managing machines of most ingenious construction and wonderful efficiency. It is said that many large boot and shoe factories have as many as forty different kinds of machines in operation. Boots and shoes are now made almost entirely of leather, that of the upper being usually softer and finer than that of the sole, but the uppers are sometimes of cloth. In the earlier days of machine industry in the boot trade the uppers were often joined to the soles by means of wooden pegs, but small metal rivets and screwed brass wire are now much more widely used. Many machines have been invented for sewing together the component parts of boots, and some of these produce work hardly, if at all, inferior to the best hand-sewing. The United States and Great Britain are the chief shoemaking countries of the world. Lynn in Massachusetts is the centre of the industry in the former country, but it is also carried on on a large scale in Haverhill and Worcester,

Mass., in various cities of Maine and New Hampshire, and in New York, Philadelphia, Baltimore, and other cities farther south. Northampton, Leicester, Stafford, Norwich, Bristol, Linlithgow, and Maybole are some of the chief centres of the industry in Great Britain. Recent years have shown a decline in the export of boots and shoes from Britain, but the number of pairs exported in 1901 was 8,142,516, valued at £1,653,190. More than five-sixths of these were sent to the colonies. The number of pairs imported in 1901, chiefly from Belgium, France, and the United States, was 3,370,048, valued at £938,909. The shoe manufacture is also carried on on a large scale in France, and for fineness of material and beauty of workmanship the French shoes are unequalled. Many of the boots, however, sold as French, are only so in so far as the fronts are concerned, which are imported in large quantities, the rest being British manufacture. The British manufactured shoes are in general more solid and durable, though less elegant, than the French. Besides leather, gutta-percha and caoutchouc are largely used in the manufacture of shoes, and a cheap kind of shoe ('clogs') is made with wooden soles. The French *sabot* is made entirely of wood. See SABOTS.

SHOOTING, in law, is an attempt to commit murder by the discharge of any kind of loaded arms, and even should no bodily injury be effected, the offender is guilty of felony, and is punishable accordingly.

SHORE, JANE, the wife of a rich goldsmith of London in the fifteenth century, and mistress of Edward IV. She was remarkable for her beauty, and likewise possessed a mind cultivated by education. Her influence with Edward, which she retained to the last, she never exercised to the hurt, but frequently to the benefit of others. After the death of Edward, in 1483, she became the mistress of the Marquis of Dorset. (See EDWARD IV.) Richard III., partly to revive among the citizens the memory of his brother's licentiousness, and partly on account of her connection with Hastings, whom he accused of being 'the chief abettor of that witch Shore,' determined to expose her to public ignominy. Laying bare his arm, all shrivelled and shrunken from his birth, he declared before the council that the incantations and witchcraft of Jane Shore and her associates had reduced him to that condition. He then had her summoned to answer against a charge of sorcery; but, unable to effect his purpose in this manner, he directed her to be tried for adultery and lewdness by the spiritual court, and she was obliged to do penance in a white sheet at St. Paul's before the whole people. She latterly fell into poverty, and appears to have died in 1526 or 1527. Her story has been consecrated by the muse of Shakspeare (Richard III.) and Rowe, and has been introduced upon the French stage.

SHOREHAM, New, a seaport town of England, in the county of Sussex, 6 miles west by north of Brighton, near the mouth of the Adur, here crossed by a suspension-bridge. It was formerly a parliamentary borough returning two members, but by the Redistribution of Seats Act of 1885 it was deprived of direct representation. New Shoreham consists for the most part of irregular streets and old houses, but has recently been much improved. There are an ancient parish church, presenting an interesting specimen of Norman architecture; various other places of worship; a grammar-school, collegiate and other private schools, and board schools; an elegant custom-house in the Grecian style, now used as the town-hall; and pleasure gardens, containing a museum,

conservatory, and theatre. The harbour is encumbered by a bar with 14 to 21 feet of water, but carries on an important trade, chiefly coastwise, and with France, Holland, the North of Europe, &c. Ship-building is to some extent carried on, and there is a productive fishery. The vessels entering the port annually have an aggregate tonnage of somewhat over 100,000 tons, the clearances being similar in amount. Pop. 1891, 3393; in 1901, 3837.

**SHORE-HOPPER** (*Orchestia littorea*), a genus of Crustaceans of the order Amphipoda, possessing the first and second pairs of feet provided with small chelæ or pincers. The maxillipedes or foot-jaws are blunted at their tips. The first pair of legs is of smaller size than the second pair. The head, as in all Amphipoda, is formed of a single segment, and the breathing organs are borne on the thoracic segments. This animal is met with on sandy coasts in company with the familiar Sand-hoppers (which see). It possesses a body more compressed than that of the latter forms, and may be known by the characters and size of the legs above-mentioned.

**SHORTHAND.** Writing or impressing words by means of signs on paper, or some other substance, is a necessity of civilized life. The ordinary method of writing is an imitation by the pen of the printed forms of letters in books, the forms being so modified that they may be joined to each other without taking off the pen. The tedious nature of this occupation has been complained of in all ages. If we assume that one person in every twenty in this country spends on an average one hour per day in this employment on 300 days of the year (a low estimate, considering that clerks and literary men are engaged six or eight hours per day), the amount of time occupied in writing by the 30,000,000 people of Great Britain and Ireland is 1,500,000 hours a day. If writing could be facilitated, so that what now requires five hours might be performed in one, 1,200,000 hours of wearisome labour would be saved to the community in this country every day. Reference is here made to only such writing as could be as well done in shorthand as in longhand—fugitive writing, as letters, articles for the press, manuscript for books, &c., which compositors can set up in type from shorthand copy as quickly and as correctly as from longhand after one or two months' study. Legal and other important documents might still be written in the longer and safer way.

A quick penman writes about thirty average words per minute, and a slow one twenty, a medium pace of writing being twenty-five words per minute. A public speaker in a slow and measured pace utters about ninety words per minute, an average speaker 120, and a rapid one 180. The difference in point of time between speech and writing is therefore as five to one.

Now as writing is a form of speech—talking on paper—it is necessary that it should be performed with the rapidity of speech, if we would derive from the art all the benefits which it is adapted to confer. We have not space here for a history of the art of shorthand as practised, probably, by the ancient Greeks, certainly by the Romans (particularly by Cicero's freedman, Tiro, to whom Cicero wrote twenty-one of his charming letters that are extant, and to whom we doubtless owe a large part of Cicero's writings), and in England from the reign of Elizabeth to about 1840. The reader's interest will be best consulted by our placing before him the principles and mode of practice of Mr. Isaac Pitman's popular system of phonetic shorthand, first published in 1837, and now brought to a marvellous degree of perfection. This system, by permission of the owners, is displayed in the following pages in such a manner

that the reader may acquire the art in a few weeks, by writing the illustrative shorthand words and practising shorthand from a book or newspaper one hour a day. Further assistance may be had from books containing set lessons, entitled *Phonographic Teacher* (6d.), *Exercises in Phonography* (1d.); *Key to both*, 6d. (Sir Isaac Pitman & Sons, Ltd., London).

In commencing the practice of shorthand the student is particularly cautioned against attempting to write with rapidity. When his hand has become accustomed to trace the simple geometrical forms of the stenographic characters with correctness and elegance, he will find no difficulty in writing them quickly; but if he lets his anxiety to write fast, overcome his resolution to write well, he will not only be longer in attaining real swiftness, but will always have to lament the illegibility of his writing. Phonography is at all times best written on ruled paper, but plain paper may be used. The learner should always write upon paper ruled with single lines, and he may use either a quill or a steel pen, or a pencil. A pencil is recommended for exercises, and a pen for ordinary writing and reporting. As, however, the reporter is sometimes so situated that he cannot use a pen, he should accustom himself, at times, to report with a pencil. The pen or pencil should be held as for longhand writing, and the elbow be turned out so that the letter  $\backslash$   $\delta$  can be struck with ease.

The following table exhibits the consonants of the shorthand alphabet.

Letter.	Phonograph.	Examples of its power.	Name.
Explosives.	P	$\backslash$	rope post pee
	B	$\backslash$	robe boast bee
	T	—	fate tip tee
	D	—	fade dip dee
	CH	/	etch chest chay
	J	/	edge jest jay
	K	—	leek cane key
Continuants.	G	—	league gain gay
	F	$\backslash$	safe fat ef
	V	$\backslash$	save vat vee
	TH	(	wreath thigh ith
	TH	(	wreathe thy thee
	S	)	hiss seal ess
	Z	)	his zeal zee
Nasals.	SH	/	vicious she ish
	ZH	/	vision * zhee
	M	(	seem met em
	N	(	seen net en
	NG	(	sing * ing
	L	/	fall light el
	R	$\backslash$	for right ar, ray
Coarcescents. Liquids.	W	$\checkmark$	* wet way
	Y	$\checkmark$	* yet yay
	Aspirate. H	$\text{?}$	* high aitch

With the exception of a straight line in the 4th position, every right-line and curve employed in Phonography, is written in the direction of one of the lines in Diagram No. 1:—



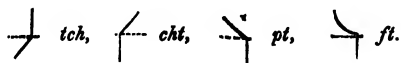
all straight lines and curves in direction 2 and the curves in direction 4 being inclined midway between a perpendicular and a horizontal line. The consonants of the Phonographic Alphabet may be remembered by observing that, except the downward *r*, *w*, and *h*, letters made by a given organ are written in the same direction. (See Diagram No. 2.)

1. LIPS:—*p*, *b*; *f*, *v*. 2. TEETH:—*t*, *d*; *th*, *dh*; *s*, *z*. 3. PALATE:—*ch*, *j*; *sh*, *zh*; *l*, *lr*, upward *r*, *ul*, *y*. 4. THROAT:—*k*, *g*; *kw*, *gw*; and NOSE, *m*, *n*, *ng*.

The consonants should be made about one-sixth of an inch in length, as in these pages. This size is best adapted for the learner, and insures accuracy and neatness in the writing. When he can write with ease, the size may be reduced to one-eighth of an inch, as in the short-hand specimen at the end of this article. Particular attention should be paid to the forms of the curved thick letters; if they are made heavy throughout, they present a clumsy appearance; they should be thickened in the middle only, and taper off at each end.

Perpendicular and sloping letters are written from top to bottom, and horizontal letters from left to right; thus, *t*, *p*, *th*, *r*, *k*, *m*, *n*. The letter *l*, when standing alone, is written upward, and *sh* downward: *l*, and *sh*, joined to other consonants, may be written either upward or downward, as may be convenient; thus,

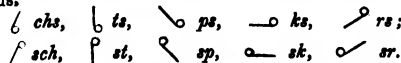
*ll*, *lm*, *shn*, *shn*. All the consonants in a word should be written without lifting the pen, the second letter beginning where the first ends, and so on; as, *kt*, *tk*, *nt*, *fn*, *fl*, *trt*. When a straight consonant is repeated, there should be no break between the two strokes; thus, *kk*. When a curved consonant is repeated, repeat the curve; thus, *nn*, *mm*. Single consonants, and combinations of consonants similar to those just given, rest upon the line; thus, *catch*, not *catch*. When two descending letters are joined, the first should be made down to the line, and the second below; thus,



As the straight line in direction 4, Diagram 1, may be written either up or down, it is made to represent two letters, namely, *ch* when written downward, and *r* when written upward: this additional sign is given to *r* for convenience and speed in writing. To diminish the risk of *ch* and *r* being mistaken for each other, when standing alone, *ch* is made to slope 60 degrees from the horizontal, and *r* 30. This line naturally takes these slopes when struck by the hand downward and upward respectively. The upward *r* is written as in the following examples:—*tr*, *rt*, *pr*, *rp*, *mr*, *nr*. When *r* has to be written alone, or joined to the circle-*s* only, either the downward form may be used; thus, *r*, *rs*,

*sr*, *rs*, or the upward *r*; thus, *r*, *rs*, *sr*, *rs*. When joined to other letters, *ch* and *r* are distinguished by the direction of the stroke; thus, *chr*, *rch*, *kr*, *kch*, *tr*, *tch*, *mr*, *mch*.

*S* and *z*, on account of their frequent occurrence, are furnished with an additional character, particularly convenient for joining; thus *o*, which represents either *s* or *z*. When the *s* circle is joined to straight letters, it is written on the right-hand side of perpendicular and downward sloping letters, and on the corresponding or upper side of horizontal and upward sloping letters, or by a motion contrary to that of the hands of a clock; thus,



When joined to curved letters, it is written inside the curve; thus, *fs*, *sf*, *ss*, *ms*, *ns*, *msm*. Between two straight lines, it is written on the outside of the angle; thus, *kst*, *tsk*, *pst*, *chsp*. When the circle *s* is joined to *l* only, *l* is written upward; thus, *ls*, *sl*, and when *s* is joined to *sh* only, *sh* is written downward; thus, *shs*, *ssh*.

There are six simple long vowels in the English language, viz.,

AH, EH, EE; AW, OH, OO;



as in *alms*, *ale*, *eel*; *all*, *ope*, *food*.

The first three are represented by a dot, and the last three by a short stroke or dash, written at right angles to the consonant. They are here written to the letter *t*, to show their respective places; namely, at the beginning, middle, and end of a consonant. ALL the vowels should be pronounced as single sounds; that is, *ah* as in *alms*, and not as *a-itch*; *eh* (*a*) as in *ape*; *ee* as in *eel*; *aw* as *awe*, not as *a-double-you*; *oh* as *owe*; *oo* as in *ooze*.

When a vowel is placed on the left-hand side of a perpendicular or sloping consonant, it is read *before* the consonant; and when placed on the right-hand side, it is read *after* the consonant. A vowel placed above a horizontal letter, is read *before* the consonant, and when written under, is read *after* the consonant. An upstroke, as *l*, *r*, has the vowels' places reckoned from the bottom upward, and when joined to another consonant and written downward, its vowels' places are reckoned downward. Vowels placed at the beginning of a consonant, as *ah* and *aw*, are called *first-place vowels*; vowels written in the middle, *second-place vowels*; and those at the end, *third-place vowels*. The vowel points and strokes must be written at a little distance from the consonants to which they are placed. If allowed to touch, except in a few cases which will be mentioned hereafter, they would occasion mistakes.

Besides the six long vowels already explained, there are in the English language six short vowels, as heard in the words

*pat*, *pet*, *pit*; *not*, *nul*, *foot*.

In producing these sounds the positions of the vocal organs are nearly the same as in uttering the long vowels in

*palm*, *pate*, *peat*; *nought*, *note*, *food*; the chief difference being, that the former vowels are more rapidly pronounced. The slight difference in the

quality of sound in these pairs is most evident in *note*, *nut*. The short vowels are represented by dots and strokes written in the same places as for the long ones, but made lighter, to indicate their brief character; thus,

$\dot{a}$ ,  $\dot{e}$ ,  $\dot{i}$ ;  $\dot{o}$ ,  $\dot{u}$ ,  $\dot{oo}$ ;  
as in *am*, *ell*, *ill*, *on*, *up*, *foot*.

These short vowels should not be called — No. 1, "short *eh*;" No. 2, "short *ee*;" No. 3, "short *i*," etc.; but—No. 1, "short *ah*;" No. 2, "short *eh*;" No. 3, "short *ee*," etc. But it is more convenient to affix the letter *l* to each of these short vowels, and call them severally *at*, *et*, *it*, *ot*, *ut*, *ödt*.

The double vowels heard in the words *ice*, *owl*, *boy*, are represented by small angular marks,  $\angle$  in *due* by a curve and the triphthong in *wife* by an angular mark; thus,—

$\angle$ ,  $\angle$  *ice*;  $\angle$ ,  $\angle$  *owl*;  $\angle$ ,  $\angle$  *boy*;  $\angle$ ,  $\angle$  *due*;  $\angle$ ,  $\angle$  *wife*.

*I*, *ow*, and *u* are close diphthongs, accented on the second element; and *oi* is an open diphthong, accented on the first element. Each is pronounced as one syllable. *U*, as in "due, tune," is one of a series of diphthongs commencing with *i* or *y*, explained in the next paragraph. The signs for *i*, *ow*, may be written in ANY place, with respect to a consonant: *oi* is written in the FIRST place.

A series of diphthongs, whose first element is *i* or *y*, may be heard in the words *India*, *alien*, (*ii* does not occur, but the shorthand sign for it may be employed in such cases as *tarrying*, *hurrying*, where these letters make two syllables,) *idiot*, *folio*, *value* (*valioo*). Another series is formed with *oo* or *w*. Systematic signs for these diphthongs are provided in the following manner:—

<i>wah</i> $\angle$ $\angle$ <i>waw</i>	<i>yah</i> $\angle$ $\angle$ <i>yaw</i>
<i>weh</i> $\angle$ $\angle$ <i>woh</i>	<i>yeh</i> $\angle$ $\angle$ <i>yoh</i>
<i>wee</i> $\angle$ $\angle$ <i>woo</i>	<i>yee</i> $\angle$ $\angle$ <i>yoo</i>

These signs, like those for the simple vowels, are written heavy for long vowels, and light for short ones. They are seldom employed at the commencement of a word. It should be noticed that these small curved marks are written in the same positions as are the signs for the six pure vowels already learned. The *w* signs represent the form of the mouth in pronouncing *w* or *oo*, thus  $\angle$ ; and the *y* signs represent the shape of the mouth in pronouncing *y* or *ee*, thus  $\angle$ .

One of these *w* signs, slightly leaning, is joined to the upward *l* to make the double consonant  $\angle$  *wl*; thus,  $\angle$  *wail*.

The combination *wh*, in *when*, *what*, represents a single sound. It is a breath-*w*, and the common *w* may be called a vocal-*wh*; just as *f* may be considered a breath-*v*, and *v* a vocal-*f*. The breath-*w* (*wh*) is represented by enlarging the hook of *w*; thus,  $\angle$  *wh*, as in *where*. When *wh* precedes *l*, the hook of  $\angle$  *wl* is enlarged; thus,  $\angle$  *whl*, as in *whale*.

The shorthand signs for the diphthongs, and double letters of the *w* and *y* series, are always written in the same direction; that is, they do not accommodate themselves to the consonant to which they may be written, as do the signs for the simple vowels *aw*, *o*, *oo*.

The aspirate occurs in English only when preceding a vowel. It is sometimes expressed by a small dot prefixed to the vowel sign; thus,  $\dot{\angle}$  *happy*,  $\dot{\angle}$  *had*. The consonant form for this letter is generally more convenient: it is written either  $\angle$  downward, or  $\angle$  upward. The downward letter is used in words that contain no other consonant, as  $\angle$  *hay*,  $\angle$  *hoe*. When

*h* is joined to some other consonant, use that form which will most easily join with the following letter; as,  $\angle$  *hack*,  $\angle$  *honey*,  $\angle$  *holy*. When the stroke *h* is written medially, that is, between two other consonants, it must be so joined that the upward *h* cannot be read as *sr*, nor the downward *h* as *sch*; thus,  $\angle$  *unholy*.

Because of the deficiencies of the English alphabet, and the unphonetic character of our orthography, the spelling of a word is seldom a guide to its pronunciation. To write any given word, therefore, phonographically, its several sounds must first be ascertained: the phonographic letters which represent them should then be written. The practice of Phonography will improve the student's pronunciation, and train his ear to discriminate differences in orthoepy.

The circle *s* is generally used in preference to the stroke *s*; thus,  $\angle$  *sake*,  $\angle$  *soap*,  $\angle$  *suck*,  $\angle$  *piece*,  $\angle$  *task*. In such words, the vowel is placed and read to the stroke-consonant, and not to the circle *s*, to which no vowel can be placed or read. Observe particularly that the circle *s*, at the beginning of a word, is always read FIRST; and at the end of a word it is always read LAST. It may be thickened for *z*, and made double-sized for *ss*; thus,  $\angle$  *peas*,  $\angle$  *pass*,  $\angle$  *passes*,  $\angle$  *cause*,  $\angle$  *causss*.

The stroke *s* or *z* is used when a word contains no other consonant; as  $\angle$  *ice*,  $\angle$  *see*,  $\angle$  *ease*; also when a word begins with a vowel followed by *s*; as  $\angle$  *ask*.

The stroke *s* is also used (1) when initial *s* is followed by two vowels; as  $\angle$  *science*; (2) and generally as the first letter of a word beginning with *s*, vowel, *s*; as  $\angle$  *society*,  $\angle$  *Sisera*; (3) also when final *s* is followed by a vowel; as  $\angle$  *mercy*,  $\angle$  *noisy*; and (4) when final *s* is preceded by two vowels; as  $\angle$  *chaos*. The stroke *z* is used in *all* words that begin with the sound of *z*; as,  $\angle$  *zeal*,  $\angle$  *Zion*,  $\angle$  *Xerxes*.

When a vowel comes *between two consonants*, it is possible to write it either after the first or before the second; thus,  $\angle$  or  $\angle$  *cap*,  $\angle$  or  $\angle$  *cape*,  $\angle$  or  $\angle$  *keep*. Care must be taken not to write the vowel sign in an angle between two letters; as  $\angle$  which might be read either *kee-p* or *k-ahp*:  $\angle$  for *nick-nack*,  $\angle$  for *almanac*, are not so clear as  $\angle$  *nick-nack*,  $\angle$  *almanac*. The three following rules will guide to the vocalization of all monosyllables.

FIRST-PLACE VOWELS are written *after the first consonant*; as,  $\angle$  not  $\angle$  *pack*;  $\angle$  not  $\angle$  *maul*.

SECOND-PLACE VOWELS are written *after the first consonant when LONG, and before the second when SHORT*; thus,  $\angle$  *gate*,  $\angle$  *get*,  $\angle$  *cope*,  $\angle$  *cup*.

It is thus known whether a second-place vowel is long or short, independently of the heaviness or lightness of the vowel sign. THIRD-PLACE VOWELS are written *before the second consonant*; as,  $\angle$  not  $\angle$  *tick*;  $\angle$  not  $\angle$  *poor*.

In the vocalization of words of more than one syllable, the vowel should be placed to the consonant to which it belongs in dividing the word into syllables, when it is equally convenient, and when there is no danger of its being misread for some other vowel. When the

diphthongs  $\vee$   $i$ ,  $\wedge$   $ow$ , are written by themselves for the words *I*, *how*,  $\vee$   $I$  is placed ABOVE the line, and  $\wedge$  *how* ON the line.

Four series of double consonants are formed from the single consonants, on the principles shown in the following table.

Names. as in		L hook	R hook	N hook	Half Length.
<i>pee</i> P, <i>pea</i>	$\diagdown$	pl $\diagdown$	pr $\diagdown$	pn $\diagdown$	pt $\diagdown$
<i>bee</i> B, <i>bee</i>	$\diagdown$	bl $\diagdown$	br $\diagdown$	bn $\diagdown$	bd $\diagdown$
<i>tee</i> T, <i>tea</i>	$\mid$	tl $\mid$	tr $\mid$	tn $\mid$	td $\mid$
<i>dee</i> D, <i>day</i>	$\mid$	dl $\mid$	dr $\mid$	dn $\mid$	dd $\mid$
<i>chay</i> CH, <i>chair</i>	$\diagup$	chl $\diagup$	chr $\diagup$	chn $\diagup$	cht $\diagup$
<i>jay</i> J, <i>jam</i>	$\diagup$	jl $\diagup$	jr $\diagup$	jn $\diagup$	jd $\diagup$
<i>kay</i> K, <i>come</i>	$\text{—}$	kl $\text{—}$	kr $\text{—}$	kn $\text{—}$	kt $\text{—}$
<i>gay</i> G, <i>go</i>	$\text{—}$	gl $\text{—}$	gr $\text{—}$	gn $\text{—}$	gd $\text{—}$
<i>of</i> F, <i>fie</i>	$\diagup$	fl $\diagup$	fr $\diagup$	fn $\diagup$	fd $\diagup$
<i>ves</i> V, <i>vie</i>	$\diagup$	vl $\diagup$	vr $\diagup$	vn $\diagup$	vd $\diagup$
<i>th</i> TH, <i>thin</i>	$\diagup$	thl $\diagup$	thr $\diagup$	thn $\diagup$	tht $\diagup$
<i>thee</i> TH, <i>then</i>	$\diagup$	thl $\diagup$	thr $\diagup$	thn $\diagup$	thd $\diagup$
<i>es</i> S, <i>see</i>	$\circ$	sl $\circ$	sr $\circ$	sn $\circ$	sd $\circ$
<i>zes</i> Z, <i>zeal</i>	$\circ$	zl $\circ$	zr $\circ$	zn $\circ$	zd $\circ$
<i>ish</i> SH, <i>she</i>	$\diagup$	shl $\diagup$	shr $\diagup$	shn $\diagup$	shd $\diagup$
<i>zh</i> ZH, <i>vision</i>	$\diagup$	zhl $\diagup$	zhr $\diagup$	zhn $\diagup$	zhd $\diagup$
<i>em</i> M, <i>me</i>	$\diagup$	ml $\diagup$	mr $\diagup$	mn $\diagup$	md $\diagup$
<i>en</i> N, <i>no</i>	$\diagup$	nl $\diagup$	nr $\diagup$	nn $\diagup$	nd $\diagup$
<i>ing</i> NG, <i>sing</i>	$\diagup$	ngl $\diagup$	ngr $\diagup$	ngn $\diagup$	ngd $\diagup$
<i>el</i> L, <i>law</i>	$\diagup$	ll $\diagup$	lr $\diagup$	ln $\diagup$	ld $\diagup$
<i>ar</i> R, <i>ray</i>	$\diagup$	rl $\diagup$	rr $\diagup$	rn $\diagup$	rd $\diagup$

<i>way</i> whay	<i>yay</i>	<i>atth</i>	<i>hway</i>	<i>goay</i>	<i>emp</i>	<i>ler</i>	<i>rer</i>	<i>will</i>	<i>whil</i>
W wh	Y	H	kw	gw	m $\frac{1}{2}$	lr	rr	wl	whl
$\diagup$	$\diagup$	$\diagup$	$\diagup$	$\diagup$	$\diagup$	$\diagup$	$\diagup$	$\diagup$	$\diagup$
up	up	up	down	up				up	up

The following is a tabular view of the long and short vowels and diphthongs.

Short.	Long.
$\text{ä}$ $\text{ē}$ $\text{ī}$ $\text{ō}$ $\text{ū}$ $\text{ö}$	ah eh ee aw ō ōō
$\text{ā}$ $\text{ē}$ $\text{ī}$ $\text{ō}$ $\text{ū}$ $\text{ö}$	ā ē ī ō ū ōō
am, ell, ill, olive, up, foot.	alma, ale, eel, all, ope, food
$\text{ī}$ $\text{ī}$ $\text{ī}$ $\text{ī}$ $\text{ī}$ $\text{ī}$	isle, ow, owl, oil, ū, tune, wife.

The diphthongs  $\text{ī}$ ,  $\text{ow}$ , may be written in ANY position.

wā wē wī wō wū wö	yā yē yī yō yū yö
$\text{ā}$ $\text{ē}$ $\text{ī}$ $\text{ō}$ $\text{ū}$ $\text{ö}$	$\text{ā}$ $\text{ē}$ $\text{ī}$ $\text{ō}$ $\text{ū}$ $\text{ö}$

These signs are written light for short and heavy for long vowels.

As the stroke  $s$  hooked, thus  $\text{ſ}$ , is not required for *er* (the circle  $s$  joined to the downward  $r$  being equally serviceable), and as the downward  $r$ , hooked for *rr*, would be almost useless, the two forms  $\text{ſ}$   $\text{ſ}$  are given to *fr*, *thr*, and their heavy strokes to *vr*, *thr*, as extra signs.

The downward  $h$  may be reduced to a tick before  $m$ ,  $l$ , downward  $r$ , stroke  $s$ , or a hook; as  $\text{hm}$  (this outline is sufficient for the word *whom* = *hōōm*),  $\text{hl}$ ,  $\text{hr}$ ,  $\text{hs}$ ,  $\text{hthr}$ .

The line of single and double consonants at the bottom of the above table may be hooked at the end for  $m$ . The seven straight strokes may be hooked for *f*. *Mp* may be hooked initially for *mpr*, and finally for  $m$ ; and after being hooked it may be halved for *t* or *d*. *Lr* and *rr* cannot be halved.

A letter with an initial or final hook (or both an initial and final hook) may be written half-length for the expression of either *t* or *d*; thus,  $\text{—}$  *kl* or *kld*,  $\text{—}$  *wt* or *wtd*,  $\text{—}$  *mnt* or *mnd*,  $\text{—}$  (up)  $\text{—}$  (down, when joined) *lnt* or *lnd*,  $\text{—}$  *rnt* or *rnd*,  $\text{—}$  *wnt* or *wnd*.

The simple articulations  $p$ ,  $b$ ,  $t$ ,  $d$ , etc., are often closely united with the liquids  $l$  and  $r$ , forming a kind of consonant diphthong, and pronounced by a single effort of the organs of speech; as in *plough*, *brow*, *try*, *drink*, etc. The natural way of expressing these combinations in writing would undoubtedly be by some marked and uniform modification of the simple letters. It is effected thus:—

$\text{—}$   $p$ , with  $l$ , becomes  $\text{—}$   $pl$ ;  $\text{—}$   $p$ , with  $r$ ,  $\text{—}$   $pr$ ;  
 $\text{—}$   $t$ , with  $l$ , becomes  $\text{—}$   $tl$ ;  $\text{—}$   $t$ , with  $r$ ,  $\text{—}$   $tr$ .

As a curve cannot receive a hook on both sides of the stroke (for such characters as  $\text{—}$  could not be written both accurately and quickly), and as the  $r$  compounds are much more frequent than the  $l$  compounds, a hook prefixed to a curve always adds  $r$  to the primary letter (except in the case of  $\text{—}$  *wl*), thus—

$\text{—}$   $th$ , with  $r$ , becomes  $\text{—}$  *thr*;  $\text{—}$   $f$ , with  $r$ ,  $\text{—}$  *fr*.














$\text{—}$   $n$ , with  $r$ , becomes  $\text{—}$  *nr*;  $\text{—}$   $m$ , with  $r$ ,  $\text{—}$  *mr*.
















*Shl*, *shn*, *shnt*, and *rt*, upward, and *ln*, *lnt*, downward, must never stand alone, because they would then be read as other letters; thus,  $\text{—}$  *shn*, struck upward, becomes *shr* (which it represents when standing alone) if supposed to be struck downward; and  $\text{—}$  *ln*, written downwards, and standing alone, is *wl*.

















From the *pr* series of double consonants, a series of treble consonants is formed by making the hook into a circle; thus,  $\text{—}$  *spr*,  $\text{—}$  *str*,  $\text{—}$  *skr*;  $\text{—}$  *sbr*,  $\text{—}$  *adr*,  $\text{—}$  *sgr*. This principle also gives  $\text{—}$  *skw* from  $\text{—}$  *kw*; as,  $\text{—}$  *square*. These treble consonants are used initially, thus,  $\text{—}$  *straw*,  $\text{—}$  *strike*,  $\text{—}$  *scrape*,  $\text{—}$  *spray*,  $\text{—}$  *supreme*. There is no danger of *spr*, *str*, *skr*, being read as *sp*, *st*, *sk*, because in the latter case the circle  $s$  is always written on the right-hand or upper side; thus,  $\text{—}$  *sp*,  $\text{—}$  *st*,  $\text{—}$  *sk*.













Except when *spr*, *str*, *skr*, occur initially, the circle  $s$  and the hook of the double letter must be distinctly expressed; thus,  $\text{—}$  *express*,  $\text{—}$  *Exeter*,  $\text{—}$  *regis-*

















*try*,  $\text{—}$  *disclose*,  $\text{—}$  *bicycle*,  $\text{—}$  *physical*,  $\text{—}$  *rascal*. When one of the  $l$  or  $r$  hooked letters follows the circle  $s$ , and a perfect hook cannot be formed, an imperfect one will suffice; thus,  $\text{—}$  *explain*; or it may be omitted; thus,  $\text{—}$  *subskide* for *subscribe*,















 *superabide* for *superscribe*. After *t* and *d*, the circle may be turned to the right in order to form the treble consonants *skr*, *sgr*; thus,  *describe*,  *disagree*,  *disgrace*. In the combinations *dsk*, *deg*, the circle is written on the other side; thus,  *desk*,  *disguise*. *S* is joined to a consonant of the *pl* series, and to *w*, thus,  *supply*,  *settle*,  *saddle*,  *sickle*,  *suffer*,  *sway*. Occasionally it is more convenient to write the single consonants than to use a double letter of the *pl* and *pr* series; thus,  is the best form for *sensible*.




*N* following a straight letter is expressed by a small final hook on the left-hand side of a perpendicular stroke, and on the corresponding side of any other straight letter; thus,  *tone*,  *train*,  *pain*,  *cane*,  *turn*. By making the hook into a circle, *s* or *z* is added; thus,  *tones*,  *trains*,  *pains*,  *canes*,  *turns*. This circle on the left means *ns* only when it occurs at the end of a word; thus,  is not *pns-m*, but *p-s-m*. When the *s* or *z* circle is final after a straight letter, it is written on the other side: thus,  *ts*,  *ps*,  *ks*. The *ns* circle is made double-size for *nsc*; thus,  *expenses*.







A small hook at the end of a curve always adds *n*; thus,  *shine*,  *feign*,  *lean*,  *known*,  *mine*. *S* or *z* is added to the *n* hook following a curve, by making a small circle at the end of the hook; thus,  *mines*. A vowel after a letter with the *n* hook is to be read BEFORE the *n*; thus,  *men*. To express a vowel AFTER *n*, the stroke *n* must be used; thus,  *many*,  *tiny*. As the stroke *n* (and also the stroke *s*, and frequently *t* and *d*), at the end of a word, thus indicates a final vowel, the vowel may be omitted in swift writing; thus,  *pen*,  *penny*,  *Pliny*,  *fan*,  *Fanny*,  *fans*,  *fancy*.















*F* or *v*, when following a straight letter, is expressed by a final hook on the right-hand side of a perpendicular stroke, and on the corresponding side of any other straight letter; thus,  *tf*,  *chf*,  *pf*,  *kf*,  *rf* (upward),  *hf*; as in  *tough*,  *David*,  *cough*,  *lithograph*,  *turf*. There is no *f* or *v* hook to CURVED letters. The hook may be thickened for *v* if necessary. The stroke *f* after a straight letter indicates a final vowel, as  *coffee*.































The terminations *-tion* (*zhon*), *-sion* (*zhon*), *-sian* (*shan*), etc., are expressed by a large final hook; thus,  *option*,  *fashion*,  *mission*,  *version*,  *Persian*,  *nations*. When the *-tion* hook follows a curve, it is written on the inner side, like the final *n* hook. It may be written on either side of a straight line, under certain restrictions, as follows:—At the end of a straight letter beginning with a hook or circle, or springing from a curve, the *-tion* hook, when final, is written on the opposite side, that the straightness of the letter may be preserved; thus,  *oppression*,  *correction*,  *collection*,  *circulation*,  *recreation*,  *station*,  *section*,  *secretion*,  *affection*,  *selection*. In other cases, *-tion* when final, and following a straight letter, is written on the side opposite to that on which the vowel (or ac-
















cented vowel if more than one) occurs; thus,  *passion*,  *caution*,  *action*,  *rogation*,  *diction*,  *operation*,  *Persian*. This rule will show when the omitted vowel is to be read before *-tion*, and when before the previous consonant. After simple *t* or *d*, the *-tion* hook is always written on the right; as  *addition*. When *shon* or *zhon* follows the circle-*s*, it is expressed by continuing the *s* circle to the other side of the consonant; thus,  *decision*,  *possession*,  *possession*,  *transition*,  *compensation*. In this case, the hook *-tion* may be vocalised for a second or third-place vowel only, by writing the vowel-sign BEFORE the end of the outline for a second-place vowel, and AFTER it for a third-place vowel, as in the above examples. This hook is used only when a vowel comes between *s* and *-tion*, not in such words as  *question*.











The circle *s* or *z* may be added to this back hook, and it may occasionally be used in the middle of a word; thus,  *positions*,  *positional*,  *transitional*.






























The *n*, *f*, and *-tion* hooks may be used medially; as,  *vanish*,  *perfection*,  *national*; and the *-tion* hook may be thickened for *-sion*; thus,  *artesian*,  *derision*,  *vision*.












By halving any consonant, whether single, double, or treble, *t* or *d* is added, according as the letter is thin or thick; *t* being generally added when the letter is thin, and *d* when it is thick; thus,  *talk*,  *talked*,  *bake*,  *baked*,  *rip*,  *ripped*,  *live*,  *lived*,  *rub*,  *rubbed*,  *beg*,  *begged*,  *trot*,  *bride*.









A vowel BEFORE a half-sized consonant is read before both letters; as,  *east*,  *eased*,  *oft*,  *ached*,  *act*. A vowel AFTER a half-sized consonant is read next to the PRIMARY single, double, or treble letter; thus,  *coughed*,  *point*,  *taint*,  *bread*,  *street*. *M*, *n*, *l*, and *r* are shortened for the addition of *t*, and these shortened strokes, when thickened, represent *md*, *nd*, *ld*, *rd*; thus,  *tempt*,  *desemed*,  *sent*,  *send*,  *old*,  *appeared*. The only consonants that do not admit of being halved for the addition of *t* or *d* are  *ng*,  *mp*,  *lr*, and  *rr*, but *mp*, when hooked finally, may be halved, for example,  *impend*. *Lt*, when standing alone, is written upward; in other cases, either upward or downward: *ld* is always written downward; thus,  *lute*,  *melt*,  *pelt*,  *knelt*,  *fold*. *D* is added to both light and heavy letters, for the past tense; as,  *melled*,  *peopled*,  *ordered*,  *measured*.






To express *d* or *v* by a final hook, instead of *t* or *f* the hook is thickened; thus,  *attained*,  *pained*,  *lend*,  *strife*,  *strive*. The thickening of the *n*, *f*, and *-tion* hooks is not necessary except when precision of sound is required. A half-sized letter may represent either an added *t* or *d*; as,  *mind*,  *font*,  *fond*,  *upward*,  *downward*,  *forward*, (*wd* being used as a contraction for *ward*),  *rapid*,  *repeated*,  *alphabet*,  *between*. A full-sized and a half-sized consonant, or two half-sized consonants, should not be joined unless they form an angle at the point of union; because it would sometimes

be doubtful whether such combinations were meant for a single letter, or a full-sized and a half-sized letter, or two full-sized letters. For instance, *k* and *kt*, *l* (upward) and *kl*, *tr* and *tt*, *d* and *dt*, *nt* and *mt*, are not allowable combinations: these double consonants should either be resolved into their simple letters, or the pen should be taken off; thus,  *kicked*,  *treated*,  *intimate*,  *practicable*. The half length consonants are named — *ket*,  *gent*,  *art*,  *elt*,  *emt*,  *emd*,  *willt*, etc.

*St* (and sometimes *zd* when final,) is written by a loop about half as long as a consonant, on the same side as the circle *s*; as,  *state*,  *stop*,  *stock*,  *steam*,  *still*,  *toast*,  *kissed*,  *fast*,  *last*,  *rest*,  *disposed*. This loop is used chiefly as initial or final, but it may be employed medially when the loop can be distinctly formed; as in  *testify*,  *justify*,  *investigation*. A wider loop, two-thirds of the length of a consonant, represents *str*; thus,  *faster*,  *muster*,  *minister*. The use of the *str* loop INITIALLY and MEDIALLY is not recommended:  *strap* cannot be halved for the past tense: write  *strapped*. These loops may be combined with the initial *pr* and the final *pn* series of straight letters; thus,  *stoker*,  *against*,  *cleansed*,  *punster*,  *stopper*. *S* may be added to a final loop or to the large *ss* circle by continuing the stroke of the loop or circle; thus,  *crusts*,  *lists*,  *dusters*,  *punsters*,  *exercises*.





When a curved consonant is written twice its usual length, it expresses the addition of  *thr* *tr*, or *dr*; but the characters *ng* and *mp*, when doubled, become *ngker* or *ngger*, *mper* or *mber*; thus,  *father*,  *neither*,  *mother*,  *letter*,  *order*,  *distemper*,  *chamber*. These double-length consonants may be hooked for *n*, as  *slander*,  *inventor*,  *thunder*. They are vocalized like the half-length ones. They should not be adopted by the learner until he has gained some degree of fluency in writing.





The long vowels *ah*, *eh*, *ee*, may be expressed BETWEEN the two letters of one of the *pl*, *pr* series of double consonants, by a small circle BEFORE or ABOVE the consonant; thus,  *dear*,  *careless*. The SHORT vowels *æ*, *è*, *é*, are written by a small circle placed AFTER or UNDER the consonant; as,  *Charles*,  *tell*,  *till*,  *gardener*. When the position of the consonants renders it inconvenient to observe this rule, the circle may be written on EITHER side, for either a LONG or a SHORT vowel; thus,  *regard*,  *engineer*.

A stroke vowel is struck THROUGH the consonant; thus,  *court*,  *cold*,  *school*,  *record*,  *soldier*. When an initial hook or circle would interfere with a first-place vowel, or a final hook or circle with a third-place vowel, the vowel-sign may be written









at the BEGINNING or END of the consonant; as,



















 *dormouse*,  *figuration*,  *figures*.









The following prefixes are written near the remaining part of the word, but in reporting (except the dot *con*.) it is frequently allowable to join them, to save time. *CON* or *COM* is expressed by a light dot, written at the beginning of the word; thus,  *contain*,  *comply*. When preceded by a consonant, either in the same or the preceding word, *con* or *com* is understood by writing the syllable that follows, UNDER or CLOSE TO the consonant that precedes; thus,  *inconstant*,  *accomplish* (in practice, the vowel of *ac* may be omitted),












 *decompose*,  *discompose*,  *discontent*,  *irreconcilable* (with the downward *r*.)

 *reconcilable* (upward *r*.),  *misconduct*,  *recommend*,  *uncommon*,  *unconfined*.

















 *you will comply*,  *I am content*,  *and contrive*,  *and compare*,  *and connected*,  *and consented*,  *has commenced*,  *and is content*. (See the signs for *and*, *has*, *is*, below.)



*INTER*, *INTRO*  *as*,  *interview*,  *introduction*. *MAGNA*, *MAGNI*  *as*,  *magnanimous*,  *magnify*. *SELF*  *as*,  *selfsame*;  *self-control*. The prefix *IN* may be expressed before the treble consonants *spr*, *str*, *skr*, and before *h*, by a back hook; thus,  *inspiration*,  *instruct*,  *inscription*,  *inherit*,  *inhuman*. This abbreviation cannot safely be used in *insolvent*, etc., because  *insolvent*,  *unholy*, would not be sufficiently distinct from  *solvent*,  *holy*.

In such cases write with stroke *n* as  *insolvent*. A prefix resembling in sound any of the above may be written in the same manner; thus,  *accompany*,  *recognize*,  *circumspect*,  *circumstances*,  *circumscribed*,  *incumbent*,  *enterprise*.

The following affixes are written near the preceding part of the word:—*ING* is expressed by a light dot at the end of a word; thus,  *eating*; or by the alphabetic  *as*  *parting*. *INGS* is written by  *as*  *ings*, or the alphabetic form  *ings*, as  *doings*,  *engravings*,  *sayings*. The dot *ing* (·) or tick *ings* (˘) should be used only when  *as* does not join well. The consonant  *as* should always be written after the circle *s*.

—*ALITY*, —*ILITY*, —*ARITY*, etc. Any consonant when disjoined from that which precedes it, expresses thereby the addition of *ality* or *arity*, or any other termination of similar sound; thus,



			
			
			
			

*LY*  *as*  *heavenly*. This affix does not interfere with *-ality*. It is generally more convenient

to join the *i*; as *goodly*. MENTAL, MENTALITY as *instrumental* or *instrumentality*; *fundamental*. SELF as *thyself*. SELVES, as *themselves*. SHIP as *stewardship*. Sometimes the two letters *sh*, *p*, can be written faster, if joined, than a separate *sh*; thus, *friendship*. A logogram (or word-letter) may be used either as a prefix or affix; thus, *Lordship*, *afternoon*, *undertake*, *hereafter*.

Phonography may be written either IN FULL OR IN

BRIEF. Full Phonography signifies the expression of every vowel and consonant in a word by its shorthand letter. In Abbreviated Phonography every word of frequent occurrence is represented by one or more of its prominent letters. These words are called Grammalogues or Letter-words, and the letters that represent them are called Logograms, or Word-letters. Thus, each of the following words in line 1 is represented by the under-written shorthand letter in line 2, which forms part of the word when written in full, as in line 3:

1. of, to, for, be, are, have, which, from.
2. 
3. 

GRAMMALOGUES—ALPHABETICALLY ARRANGED.

A, an	deliver-ed-y	have	Nature	shall, shalt	up
above	different	he	near	short	upon
according	difficult	him	no	should (up)	us
after	do	himself	nor	so	use ( <i>verb</i> & <i>noun</i> )
ago	Doctor	how	not	spirit	usual
all	done	however	number	Thank	Very
and (up)	down	I	Oh! oh! owe	that	Was
any	during	if	of	the	we
are	Each	important	on	their, there	what
as	equal-ly	improve-d-ment	one	them	when
at	ever-y	in	opinion	these	whether
awe	First	is	opportunity	thing	which
Be	for	it	or	think	while
because	from	Language	other	this	who
been	General	large	our	those	whose
beyond	gentleman	Lord	out	though	why
but	gentlemen	May	over	through	will ( <i>verb</i> )
by	give-n	me, my	Particular	to	with
Call	go	member	Phonogra-phy	to be	without
can	God	mere	pleasure	told	word
cannot	good	might	princip <sup>al</sup>	toward	would
care	great	more	put	true	Year
come	Had	Mr	Remember-ed	truth	yet
could	hand	much	See	two, too	you
Dear	happy	myself	several	Under	your

There are two Styles of Abbreviated Phonography; the First is used in correspondence, and for general purposes; and the Second is employed by reporters. The First Style is generally called "Corresponding," and the Second Style, "Reporting." These two Styles differ chiefly in the number of grammalogues employed. In the First Style about 150 are used. Logograms that are written *above* the line (except horizontal and vowel logograms,) or *through* the line, cannot be employed on

unruled paper. These words should, in that case, have their remaining consonants or vowels inserted.

*S* may be added to a logogram to mark the plural number or the possessive case of a noun, or the third person singular of a verb; as — *good*, — *goods*, — *Lord*, — *Lord's*, — *come*, — *comes*. In general, the positions of the grammalogues, *ABOVE*, *ON*, and *THROUGH* the line, are determined by their vowels; and in the case of a word of more than one syllable,

by its accented vowel. The positions of words, as determined by their vowels, are:—For perpendicular and sloping strokes, 1st position, *ah, aw, i, oi*, ABOVE the line; 2nd position, *a, o, u*, ON the line; 3rd position, *e, oo, ow, u*, THROUGH the line.

Vowel logograms, and horizontal and half-sized consonants, have but two positions:—1, *ah, aw, i, oi* ABOVE the line. 2, *eh, oh, ee, oo, u, ow*, ON the line.

All grammalogues are written IN POSITION in accordance with the above rules, and are thus easily remembered, except,—IRREGULAR GRAMMALOGUES.—CLASS 1.—Words of frequent occurrence, written ON THE LINE for the sake of convenience. They are:—*are, be, been, dear, do, for, from, have, he, if, it, Lord, Phonography, shall, think, upon, usual, was, we, which, will, your*. CLASS 2.—Words which in their proper position would clash with some other grammalogues. They are:—*any, go (and ago), in, me, more, much, number, O, over, particular, this, those, though, truth, with, your*.

Seeing that in the Phonographic Alphabet the letters *s* and *r* have duplicate forms, that *sh* and *l* may be written either upward or downward, that *vo* and *y* have both vowel and consonant forms, that *k* may be written by its consonant form (up or down), or by a joined tick, or a dot; also that many groups of consonants may be expressed either by their alphabetic forms or by abbreviations, it is evident that a large number of words may be written in more than one way. For any given word the writer should choose that form which is most easily and rapidly written, and is at the same time capable of being clearly vocalized. The briefest outline to the eye is not always the most expeditious to the hand. The student will insensibly acquire a knowledge of the best forms by practice and observation, and especially by reading some book printed in Phonography. The following rules for writing the upward *l* and *r* affect a large number of words.

INITIAL *R*.—When *r* is the first consonant in a word, the upward *r* is written, if a vowel follows, and the downward *r* is written if a vowel precedes; thus, *ray*,

*rock*, *run*, *rise*, *rule*;  
*air*, *arm*, *earl*, *error*.

This rule should not be applied when it would produce an awkward outline, as in *arid-ity, arithmetic, artichoke, article, earth, irradiate, oracle, origin-al, ornament, orthodox, orthography*; and a few others.

FINAL *R*.—The same rule applies to final *r*; as,

*tare*, *tory*; *fear*, *fury*; *pare*,  
*perry*; *car*, *carry*; *cheer*,  
*cherry*. It applies also when a hook, circle or loop

is attached to *r*; as, *earn*, *airs*, *Sir*,  
*star*, *concern*, *stern*, *source*. The rule does not apply when it would carry the hand more than one stroke below the line, as in *prepare*, and *Shakspeare*; nor when *r*, *r* follow each other; as in *rare*, *superior*, *emperor*.

INITIAL *L*.—The rule applies to initial *l* when followed by *k, m, n, ng*; as, *like*, *lament*,  
*Lena*, *long*; *alike*, *alum*, *element*, *Ellen*, *along*.

FINAL *L*.—The rule applies to final *l* when preceded by *f* (or *v*), upward *r*, upward *h*, stroke *w* and *y*, or *sk*; as, *fool*, *fellow*, *vale*, *valley*,  
*roll*, *relay*, *skill*, *sickly*. Write *l* downward when following a straight letter, if two vowels come between; as *bowel*, *trial*.

In the case of a word that contains no other stroke-consonant than *r*, with a vowel both before it and after it, write the downward *r* if there is ONLY a vowel before; as, *area*, *areas*, *array*, *arrays*,  
*arise*; if MORE THAN a vowel precedes, write the upward *r*, as *sorry*, *serious*, *serene*, *story*,  
*Styrian*.

*FR, THR*, ETC.—The two forms for *fr*, *or*, *thr*, should be used thus:—In the case of a word that contains no other consonant stroke, *fr* should be employed when a vowel follows; as, *fry*, *throw*, and the other series when a vowel, or the prefix *com*, *con*, precedes; as, *offer*, *ether*, *comfort*. These two classes of words will thus be more readily deciphered in unvocalized Phonography, or Reporting. In other cases, that is, when another stroke comes before or after, select that form of *fr*, *thr* which makes the most convenient outline. If both forms are equally convenient, *fr*, *thr* should be preferred, as agreeing with the *pr* series.

JOINED VOWELS.—At the beginning of a word, a vowel may be joined to a consonant in the following cases: *aw* before *l* (upward); *waw, wö*, before *k, r* (up), *m, tr, chr*, and *shr*; and the diphthong *i* before *t, sh, s, th, p, f, r* (down); thus, *alter*, *alteration*,  
*walk*, *war*, *water*, *item*. A vowel may also be joined at the end of a word in such cases as *about*, *due*, *new*, *continue*. The vowel *aw* (all) may be joined in *Almighty*, *almost*, *already*, *although*, *always*, *all-wise*.

JOINED VOWEL SIGN FOR *W*.—The small *w* may be advantageously joined to *k, m*, and *l*; as, *wake*, *woke*, *wag*, *woman*, *wall*, *William*, *Wilson*. Before other consonants it is better to write the alphabetic *w*.

YOO OR U INITIAL.—Short words that commence with *u* (*ü* or *yoo*) are best written with the consonant *y*, as the first element of the diphthong; thus, *unite*, *unity*, *union*. An initial *y* should be written in such words as, if left unvocalized, might be read for other words. The expression of *y* is not necessary in words that contain three other consonant strokes; as *unanimous*, *university*, *universal*, *unanimity*.




Contractions.—When *P* occurs between *m* and *t*, *T* between *s* and another consonant, *K* between *ng* and *sh*, or *ng* and *t*, or *G* between *ng* and *sh*, the *p, t, k*, or *g* may be omitted in Phonography; as,

*P*. *stamped* (from *stamp*), *cramped*,  
*thumped*. *T*. *mostly*, *restless*, *postpone*; also in *postage stamps*, *testament*,  
*New Testament*, *testimony*, etc. *K*.  
*Anxious*, *sanction*, *distinct*. *G*. *distinguish*.

OF THE.—The connective phrase "of the," is intimated by writing the words between which it occurs NEAR TO EACH OTHER, thus showing that the one is of the other; thus, *love of the beautiful*, *plan of the work*.

TICK *THE*.—*The*, the most frequent word in the

English language, may be expressed by a short slanting stroke  $\swarrow$  joined to the preceding word, and generally written downward; thus,  $\swarrow$  in the,  $\swarrow$  for the,  $\swarrow$  of the,  $\swarrow$  with the,  $\swarrow$  to the; but when more convenient, it is written upward; thus,  $\nearrow$  at the,  $\nearrow$  on the. The first stroke of *on the* is made sloping to keep the sign distinct from  $\swarrow$ .

Certain words of frequent occurrence are contracted by the omission of a portion of the outline:—(1) by employing the first two or three strokes of the outline as  *expect*. (2) The omission of *k* in words ending in *action*, etc., as  *objection*. (3) The omission of a medial consonant, as  *passenger*.

In longhand, swift writers join all the letters of a word together, and sometimes write several words without lifting the pen. In Phonography also several words may often be united. This practice, called Phraseography, gives great assistance to the writer in following a rapid speaker. The following examples show how other phraseograms may be formed. Words marked ( \* ) are written above the line.

1 and have	6 it is	6 this is
1 and the *	6 it is not	X to be
6 as well as *	6 it is said	✓ we are
~ could not	h it should be	~ we have not
J had not *	✓ it would be	~ we have seen
J do not *	~ may be	6 which cannot
e has not *	6 of course *	~ you can
~ I am *	X should be	~ you cannot
1 I do	4 should do	~ you may
1 I have	~ so that	~ you must
✓ I will *	✓ they will	~ you must not
e is not	6 that is *	1 you will do

Stops should be written in the usual way, except the Period, for which a small cross is used; thus, , ; : x The Hyphen is written thus, |, • *two-fold*; the Dash thus, —; ¶ A smile; / used in correspondence, but not in printing. The parenthesis stroke should be made a little larger than a double-length upright consonant.

ACCENT may be shown by writing a small cross close to the vowel of the accented syllable; thus,  $\tilde{x}$   $\delta$  arrows,  $\delta^a$  arose,  $\tilde{r}_2$  renewed. It is, however, more convenient to use Phonetic Longhand when marking the accent of a word.

EMPHASIS is marked as in longhand, by drawing one, two, or more, lines underneath; a single line under a single word must be made wave-like, thus ~, to distinguish it from — *t*. In preparing manuscript for the press, a single line thus drawn underneath, (wavy for a single word, and straight for more than one,) signifies *italic*; two lines (which need not be waved) SMALL CAPITALS, and three lines LARGE CAPITALS. For *ITALIC CAPITALS* draw three lines, and write “*Italic*” in the margin.

AN INITIAL CAPITAL is marked by two short lines under the word; thus, *h<sup>v</sup>* *The Times* newspaper, *Abel*.

FIGURES are written as usual, or the words may be expressed in Phonography. When the figures *one* and *six* are written by themselves, they should be formed thus, *1*, *6*, that they may not be mistaken for shorthand characters.

## ADVANTAGES OF SHORTHAND.

[illegible]

**TRANSLATION.**

“A practical acquaintance with this art is highly favourable to the improvement of the mind, invigorating all its faculties, and drawing forth all its resources. The close attention requisite in following the voice of the speaker induces habits of patience, perseverance, and watchfulness, which will gradually extend themselves to other pursuits and avocations, and at length inure the writer to exercise them on every occasion in life. When writing in public it will also be absolutely necessary to distinguish and adhere to the train of thought which runs through the discourse, and to observe the modes of its connection. This will naturally have a tendency to endue the mind with quickness of apprehension, and will impart an habitual readiness and distinctness of perception, as well as a methodical simplicity of arrangement, which cannot fail to conduce greatly to mental superiority. The judgment will be strengthened and the taste refined, and the practitioner will by degrees become habituated to seize the original and leading parts of a discourse or harangue, and to reject whatever is commonplace, trivial, or uninteresting.”

The above system is more complex than the older shorthands, two of which (Taylor's and Gurney's) are still employed. In these there is little to be learned beyond the alphabet; and as they do not employ the distinction of heavy and light strokes, and strokes of various lengths, more freedom of penmanship is possible. But they require more movements of the hand in writing a given passage. Latterly attempts have been made to give fuller expression to vowels, as in Pocknell's system and that of Professor J. D. Everett. Of systems that have recently come rather prominently forward, one is the Oxford Shorthand, which has been introduced into various schools, and seems to be making progress in public estimation. It is written on one slope, its signs are few and simple, and the vowels and consonants are joined and written in their natural order. Another system is known as Script Shorthand, and is said to have already yielded valuable results. In America the leading system is Pitman's, in Germany Gabelsberger's, which has also been adapted to English and other languages. In France, Prévost's, a modification of Taylor's is much used.

#### SHORT-SIGHTEDNESS. See SIGHT.

**SHOT**, a term applied to any projectile whose effect depends simply upon the blow it delivers on impact, there being no bursting charge. As applied to heavy ordnance it comprises solid and hollow shot, grape, case, &c. Grape and case shot are small iron balls held together when fired. Shot is also the term for the small round pellets of lead used with sporting guns for shooting small animals and birds. This kind of shot is made by dropping the melted lead through the holes of a colander set at a considerable height (100 to 150 feet) above water, the drops naturally assuming the globular form and hardening as they fall through the air. A little arsenic is added to the lead to give greater hardness. See SHELL, GUN, GUNNERY, &c.

**SHOULDER-JOINT**, the articulation of the upper arm or humerus with the glenoid cavity of the scapula or shoulder-blade. This joint forms an example of the *enarthrodial* or ball-and-socket joints; the ball-like or rounded head of the humerus working in the shallow cup of the glenoid cavity. Such a form of joint necessarily allows of very considerable movement, and the shoulder-joint may be deemed of peculiar kind on various accounts. Thus, the head of the humerus is very large when compared with the glenoid or receiving cavity. The capsule which surrounds and incloses the joint is of very loose nature, but is intimately connected with the muscles which are attached to the head of the humerus. The joint itself is guarded against dislocation or displacement by the strong ligaments surrounding it, as well as by the tendons of its investing and other muscles; whilst superiorly the acromion and coracoid processes of the scapula (which see) form an arch, together with the coraco-acromial ligament, which further serves to protect the joint. The articulating surfaces are covered with cartilage, the deposit of this material on the glenoid cavity being thin in the centre of the cavity, and thicker round its margin. The cartilage covering the head of the humerus is thickest in the centre.

The *capsular ligament* forms the chief structure of ligamentous nature in connection with this joint. It incloses the joint, and is attached superiorly to the margin of the glenoid cavity above the glenoid ligament; whilst inferiorly it is fixed to the humerus at its 'anatomical neck.' This ligament is much thicker in its upper than in its lower portion. It is lax in structure, and admits of the free separation of the humerus from the scapula. The *coraco-*

*humeral ligament* springs from the outer part of the coracoid process, and passes downwards and outwards to the front of the great tuberosity of the humerus. It becomes united below to the supraspinatus tendon; whilst it is attached to the capsular ligament throughout nearly its entire extent. It serves chiefly to support the inner and upper portion of the last-named ligament. The *glenoid ligament* is fixed around the margin of the cavity of that name. The function of the glenoid ligament is chiefly that of deepening the cavity by adding to its circumference, and it also protects the bony edge of the cavity. The synovial membrane lines this ligament, and this membrane itself also lines the margin of the glenoid cavity, becoming reflected over the inside of the capsular ligament, and covering the neck of the humerus on its sides and lower part. The muscles which are related to this joint are the supraspinatus above, the long head of the triceps below, the subscapularis internally, the infraspinatus and teres minor externally, and the long tendon of the biceps within. The deltoid muscle lies on the external aspect of the joint, and covers it on its outer side, in front, and behind as well.

The movements of the joint consist in those of abduction, adduction, circumduction, and rotation—a 'universal' movement being thus permitted; and its free motion is further aided, when the bony surfaces are in contact, by separate movements of the scapula itself, and by the motions of the articulations between the sternum and clavicle, and between the coracoid process and clavicle also. The movements of the scapula are very well seen when the arm is elevated to its greatest extent, a movement accomplished by throwing the arm slightly forward as well as upward. The motions of the joint are not regulated by the capsule, to any great extent at least, and the looseness of this ligament has already been noted; and, as remarked by Humphry, the surrounding muscles and atmospheric pressure regulate the motions of the joint, and render its movements 'much more easy than they would otherwise have been, and permits a swinging pendulum-like vibration of the limb when the muscles are at rest.' The motions are limited and controlled by the interlocking of the bones, as well as by the tension of the capsule. The biceps muscle, in the relations of its tendons to this joint, subserves several important points. Primarily, and from its connection with both elbow and shoulder joints, it brings the movements of both into harmonious relation; whilst it strengthens the upper portion of the articular cavity, and steadies the head of the humerus, through its relation to the bicipital groove of that bone.

This joint is liable to various diseases and injuries, some of which are of very interesting nature and of frequent occurrence. Local injury may result in inflammation of the joint, whilst special diatheses or diseased conditions of constitutional origin may each give rise, either *per se* or through injuries, to such lesions as strumous or scrofulous disease of the joint, to syphilitic lesions, and to gouty or rheumatic attacks. Of the accidents to which the joint is liable *dislocations* are by far the most frequent. Thus, the head of the humerus may be displaced downwards and inwards into the armpit or axilla; or it may be luxated forwards and inwards; or driven in a backward direction on the back or dorsum of the scapula, or into the infraspinatus fossa of that bone. *Fractures* in connection with this joint are not uncommon. Fracture of the acromion process of the scapula, of the coracoid process, of the neck of the shoulder-blade, and of the upper part of the humerus, are the chief varieties

ties of these accidents. Occasionally the shoulder-joint may be discovered to present malformations of a congenital kind. Atrophy or imperfect development of the joint has been met with, leading to displacement of the humerus in various directions.

**SHOVEL, SIR CLOUDESLEY**, or more correctly, **SIR CLOWDISLEY SHOVELL**, British admiral, born of good family at Cockthorpe, Norfolk, in Nov., 1650, first went to sea at the age of fourteen. He soon distinguished himself by his talents, and for about thirteen years served in the Mediterranean against the Barbary pirates. In 1687 he was appointed to the command of a 70-gun ship, and in the following year received the command of the 48-gun *Dover*. He joined the Prince of Orange at the Revolution, and was made a knight for his services at the battle of Bantry Bay. In 1692 he was made rear-admiral of the red, and contributed much to the victory of La Hogue. In 1694 he commanded the expedition against Dunkirk; in 1704, serving under Sir George Rooke, he assisted in the capture of Gibraltar, and led the van at the battle of Malaga; and in 1705, while commanding the fleet connected with the Earl of Peterborough's expedition, assisted greatly in the taking of Barcelona. In 1706 he sailed to Portugal, and in 1707 assisted the Duke of Savoy in the siege of Toulon. While returning home he was wrecked on the Scilly Isles, when three ships were lost. He himself, barely living, was cast ashore, and was found by a woman, who murdered him in order to obtain his emerald ring.

**SHOVEL-FISH** (*Scaphiorhynchus cataphractus*), a genus of Ganoid Fishes belonging to the Sturionidae or Sturgeon family, and found in North American rivers. It is so named from the flattened form of the head, the nose being spread out as it were. The head is concave above and convex beneath. The mouth opens beneath the head, and possesses four tentacular filaments. Five rows of ganoid scales exist on the body.

**SHOVELLER-DUCK** (*Spatula clypeata*), a genus of Anatidae or Ducks, distinguished by the bill being longer than the head, and narrowed at its base, whilst the tip is hooked and broadened. The laminae or fringe-like processes of the upper mandible, are long and slender, and the nostrils are oval and situated at the base of the bill. The beak presents of course the distinctive feature of this duck, exhibiting a faint and modified resemblance to that of the Spoonbill. The average length of this bird is about 18 or 20 inches. The male possesses the head and upper neck of a bright green hue, and the lower neck white. The scapular feathers are white. The back is of a brown colour, the primary wing-feathers being blackish-brown. The tip of the wing is pale blue, as also are the lesser wing-coverts, and tertiary feathers in part. The tail and upper tail-coverts are of black colour. The breast and belly are light brown or chestnut. The colouring of the female is more sombre, and consists of various hues of brown on the upper and of lighter brown on the under parts. The Shoveller Duck is found in Britain during the winter months. Some few may remain in this country throughout the year. It feeds on worms, insects, snails, small fishes, and vegetable matters, and inhabits lake-margins and marshy spots. The nest, which is placed near water, is formed of the stems of grasses, and is lined with down. The eggs may number eight or nine. They are coloured of a creamy or brownish-white hue, tinted with green. The young do not at first possess the characteristically broad beak of the adult, this feature appearing later on in their life-history.

**SHRAPNEL SHELL**. See **SHELL**.

**SHREW-MOLE** (*Scalops aquaticus*), a genus of

Insectivorous Mammals, belonging to the family of Soricidae or Shrew-mice, but also by some zoologists placed in the Talpidae or mole family. This genus is found in North America, and possesses twelve incisors, four canines, sixteen premolars, and twelve molar teeth. The two middle incisors of the upper jaw are of relatively large size. The muzzle is long, and cartilaginous at its tip, and the nose is proboscis-like. The feet have five toes each. The tail is short, and sparsely covered with hairs. This animal is found usually near rivers and streams, and burrows after the fashion of our Common Mole. The claws of the fore feet are long and powerful, and well adapted for burrowing. The outer ears are undeveloped, and the eyes are extremely small. The average length is about 7 inches. The fur is of fine character and closely set, like that of the Common Mole.

**SHREW-MOUSE** (*Sorex*), a genus of Mammals belonging to the order Insectivora, and to be carefully distinguished from the Ordinary and Common Mice (Muridae), which are included in the order Rodentia; and from the Dormice (Myoxidae), also belonging to the Rodent order. The Shrews form the family Soricidae, and are known by their hairy bodies, and by having the feet formed for running, and not adapted for digging or burrowing, as in the allied Moles (which see), for example. The eyes are well developed, and outer or external ears are present, although usually of small size. They live either in trees or on the ground. The jaws are prolonged, and a mobile snout generally exists. The food consists chiefly of insects and their larvae, but they also appear to feed on vegetable matters. They are distributed all over the globe, and one species (*Sorex Etruscus*) is notable as being the smallest of known Mammals, averaging only about 2½ inches in length, including the tail. A large number of very different Insectivores are included under the term and in the family of 'Shrew-mice.' And between the members of nearly-related species considerable differences in dentition, form, &c., may exist, so that the family includes a great variety of very diverse forms. The genus *Sorex* includes the typical members of this group. To this division belong the Common Shrew (*S. araneus*, see plate at CHEIROPTERA, fig. 19) and the Water Shrew (*Crossopus* or *S. fodiens*) the Oared Shrew (*S. remifer* or *Crossopus ciliatus*), &c. The genus *Sorex* possesses six upper and four lower incisors, those of the upper jaw being long, curved, and notched at their bases. The lower incisors are serrated, and project in a horizontal manner. No canine teeth exist, and five small teeth—presumably premolars—exist between the incisor teeth and molars of the upper jaw (in *Crossopus* only four—see fig. 20). The molars themselves number eight in the upper and six in the lower jaw (fig. 22). The muzzle is sharp and long. The ears are broad. The feet are each five-toed, and the tail is of moderate length. The typical species are European in their distribution.

The Common Shrew or Shrew-mouse, sometimes known by the name of Erd Shrew, and sometimes scientifically designated by the name *Corsira vulgaris*, averages about 4 inches in length, the tail making up half of this measurement. This appendage is of square shape. This creature may readily be distinguished by its prolonged muzzle, and by the teeth being coloured brown at their tips. It feeds upon insects and their larvae, and inhabits dry places, making a nest of leaves and grasses. The young, numbering from five to seven, are born in the spring. These little animals are very voracious in their habits, and frequently kill and devour one another. Like most other members of this family, the Shrew-

mouse secretes a fluid of disagreeable odour in special glands, and this odour prevents larger animals from eating their flesh, although they are not unfrequently killed, probably being mistaken for ordinary mice. In former days the bite of the Shrew was accounted of venomous kind, whilst its body, variously treated, was regarded as a cure for many complaints. The fur is of reddish-brown hue.

The Water Shrew attains a total length of from  $4\frac{1}{2}$  to 5 inches. The snout is not so pointed as that of the Common Shrew. The ears are very small. Its colour is black on the upper and white on the under parts. The fur is of delicate texture, and adapted to resist the action of water. When it swims this shrew has the power of spreading out or of flattening its body, so as to increase its floating capacities. A prominent fringe of stiff white hairs is found on the tail and on the toes of this form, this fringe forming a distinctive feature of the species. The food resembles that of the Common Shrew, but aquatic larvæ appear to form a large part of its nutriment. They are of very active habits, diving and swimming with great facility.

The Oared Shrew is also an aquatic species, and is the largest of our native shrews. Its total length averages from  $5\frac{1}{2}$  to 6 inches. The hinder portion of the tail is flattened like the blade of an oar, and hence the popular name; whilst the term 'Black Water Shrew' has also been given to it, on account of its black fur of the back, which is sprinkled with whitish hairs, whilst that of the belly is interspersed with hairs of a blackish tint. A yellowish tinge marks the middle of the throat and abdomen. The feet and tail are fringed with stiff hairs, as in the preceding species. Another species of Shrew, found plentifully in Ireland and also in England, is the Rustic Shrew (*Corista rustica*).

The Elephant Shrews of Southern Africa and Algeria (fig. 21), formerly the family Macroscelidæ, may also be included under the name of Shrew-mice. These forms are distinguished by the elongation of the muzzle to form a slender proboscis-like organ, which bears the nostrils at its tip. The eyes are of moderate size, and the ears are well developed and covered with hairs. The fore feet are short, and possess five toes, whilst the hind feet are very long, and are provided with compressed claw-like nails. The tail is elongated and slender. The most familiar species are the *Macroscelides proboscideus* of Southern Africa, and the *M. Rozeti* of Algeria—the latter being known to the French as the *Rat à trompe*. The favourite attitude of these creatures is a sitting posture, much resembling that of the Jerboas and Kangaroos, and which they are enabled, like the latter animals, to assume from the greater length of hind as compared with the fore limbs. The first-named species is coloured of a dark-brown hue, which is reddish on the flanks and sides, whilst the abdomen and inner aspect of the limbs are of a grayish-white colour. The average length of the body is about  $3\frac{1}{2}$  or 4 inches, and the tail measures in itself about 3 inches. These animals inhabit rocky situations of a dry nature, and feed on insects and other small Invertebrata.

SHREWSBURY, a municipal and parliamentary borough of England, county town of Shropshire, on the left bank of the river Severn, which almost surrounds it and affords excellent boating and fishing. Four bridges span the river here, connecting the town with its suburbs. The most noteworthy churches are: Holy Cross, Norman in its earlier portions (restored 1894), with a modern chancel (1887), formerly the church of a Benedictine abbey; St. Alkmund's, mostly rebuilt in 1795; part of an old Gothic church of St. Chad. and a

new church, in classic style, dedicated to the same saint; St. Mary's, in part rebuilt after being damaged by a storm in 1894; the Roman Catholic cathedral. The grammar-school, founded in 1551, is one of the most famous in the kingdom. There are a shire-hall and guild-hall, free library and museum, market-hall, including corn exchange; prison, barracks, infirmary, &c. There are statues to Lord Clive, Lord Hill, and Charles Darwin. Parts of the old castle and of the former walls still remain, and there are some fine old timbered houses. The industries embrace glass-staining, agricultural implements, iron-founding, tobacco, tanning, malting, and brewing. The battle of Shrewsbury was fought near the town in 1403. Shrewsbury returns one member to Parliament. Pop. (1891), 28,967; (1901), 28,396.

SHRIKE, the name applied to a family (Laniidæ) of Insectorial Birds, belonging to the Dentirostral division of that order. The name of Butcher-birds is sometimes applied collectively to these birds, from their mode of treating their prey. The family itself is conveniently divided into the group of the Laniinæ or True Shrikes, and the Thamnophilinæ or Bush Shrikes. The True Shrikes are distinguished as a sub-family by possessing a bill of moderate size, the nostrils being situated laterally. The wings are elongated. The outer toe is larger than the inner, and is joined to the middle toe at its base. The hind toe is long, and its under-surface or 'pad' is broad. The typical genus *Lanius* itself is distinguished by the bill being broad at the base and hooked at the tip. The nostrils are surrounded by bristles, and bristles exist at the base of the bill also. The fourth quill is the longest in the wings, and the tail is of graduated or conical shape. The species of this genus occur throughout the Eastern Hemisphere. The allied genus *Enneootonus* possesses the third quill longest in the wings, and a rounded tail; but in other points resembles the genus *Lanius*. These birds seem to approach very closely to the characters of the Raptores or true Birds of prey. They feed chiefly upon insects, reptiles, small Mammalia, and the young of other birds. The bill throughout the family Laniidæ is sharp-edged, hooked, and marked on each side by the indentation or toothed appearance characteristic of the Dentirostral Birds generally. In the True Shrikes or Thamnophilinæ, the bill is long, and possesses an arched keel, the tip being hooked, and bristles existing at the base. The wings are rounded, and the quills from the fourth to the seventh are the longest in the wing. The tail is long, and the tarsi are covered with broad scales.

Of the True Shrikes or Laniinæ, the Red-backed Shrike (*Lanius* or *Enneootonus collurio*) is the species found in greatest abundance. It visits Great Britain in summer, migrating southwards to Africa via Italy in September, and arriving in Britain again in spring about the end of April or beginning of May. Its habits lead it to fit about the tops of hedgerows and low trees, usually in pairs. The food consists chiefly of insects; and the male bird is said to impale the insects on the thorns of hedges to save his mate the trouble of looking for them on her own account. This bird also attacks the young of other birds. The nest is built generally on the tops of hedges or in bushes, and is of large size, being composed of grass and roots lined with hair. The eggs, numbering five, are coloured white, tinted with blue, green, or sometimes with red. The males of this species are coloured gray on the head, neck, and shoulders, a black mark crossing the eye from the base of the bill. The back and wing-coverts are of a red chestnut hue, passing into reddish-gray on the tail. The under-surface of the chin is white, and the under parts generally are

tinged reddish. The beak is black. The females are coloured reddish-brown on the upper parts, and the under portions of a grayish-white. The black mark across the eye is replaced in the female by a light stripe above the eye. In average length this species measures from 6 to 7 inches.

The Great Gray Shrike (*Lanius excubitor*) is found in many portions of Europe, and makes its appearance in Britain during winter. This species is coloured gray on the upper and white on the under parts; the quills of the tail being black with white tips, whilst a band of black crosses the forehead, surrounds the eyes, and terminates behind on the ear-coverts. The average length is about 9 or 10 inches. The nest is built in high trees; and the eggs, numbering from four to six, are of a bluish-gray colour spotted with brown. The song is said to be harsh, but considerable imitative powers in this respect are possessed by this bird. The food consists of mice, shrew-mice, frogs, and insects; and these birds have the curious habit of suspending their prey upon thorns, or the branches of a tree, in order to tear it with greater ease. Even during captivity this bird has been observed to suspend its food from the wires of its cage.

The Woodchat Shrike (*L. or E. rufus*) attains a size approaching that of the Red-backed species. It is of rare occurrence in Britain, but is found on the Continent, in North Africa, and the Cape of Good Hope. The head and neck are coloured of a chestnut red in this bird, a white mark running across the base of the bill, and a black band crossing the forehead, and surrounding the eyes as in the preceding species. The wings and wing-coverts are black, the upper tail-coverts being white. The primaries of the wings have white bases, and the secondaries possess white tips; whilst the two central tail-feathers are black, the two outer ones being white. A white colour prevails generally on the under surface of the body. The head and neck of the female are of a dusky shade than in the males, the back being of a brownish-black hue, and the breast grayish-white. The nests are most frequently found on oak-trees, and the eggs are of a bluish-white colour mottled with brown.

Of the Bush Shrikes, Vigors's Bush Shrike (*Thamnophilus Vigorsii*) of South America is a good example. This bird attains a length of from 12 to 13 inches, and is of powerful make; the bill being sharp and strong, and the claws strongly curved. These birds chiefly inhabit bushes and thick woods. The colour of the male is a general black on the upper parts, barred transversely with reddish brown; the under portions being grayish-brown. The head possesses a crest of erectile red feathers, marked with black tips. The crest of the female is black.

Two shrikes belonging to the Laninae occur in North America, one of these latter species very closely resembling the Gray European Shrike. In the East Indies species of these birds are also represented, and in Australia the genus *Falcunculus* contains typical examples of the sub-family. The *Oreocica cristata* of Australia appears to live chiefly on the ground, and is noted for its peculiar and somewhat ventriloquial song, which begins with low notes, and gradually increases in height and power, so as to delude the observer into fancying that the near and stationary songster has been gradually coming from a great distance towards him.

The name of Cunningham's Bush Shrike has been given to the *Gubernates Yetapa* of ornithologists found in South America, and which, although closely resembling the True Shrikes in appearance and habits, is yet included in a distinct and separate family, that of the Muscipidae or Fly-catchers, and in the sub-family Alcedrininae. The Drongo Shrikes, belonging

to the sub-family Dicurinae; the Piping Crow Shrike (*Gymnorhina tibicen*); and the Pied Crow Shrike (*Strepera graculina*) of New South Wales, belonging to the Conirostrata section of the Insectores, may also be mentioned as being included under the designation of shrikes, although removed from the typical group of the latter birds.

SHRIMP (*Crangon*), the name applied to a genus of well-known Crustaceans, belonging to the order Decapoda, or that which also includes the familiar Crabs and Lobsters. The term 'Shrimp' is, however, also applied in a popular sense to many other Crustaceans belonging to different orders of the class, and hence it will be necessary, firstly, to describe the characters of the typical and familiar shrimp, and, secondly, to note the chief among the diverse forms also designated by this term. The family Crangonidae, to which the familiar shrimp belongs, is distinguished by the fact that in its members both pairs of antennae or feelers are situated on the same line, and the first pair of legs is provided with small chela or nipping-claws. In the typical genus *Crangon*, of which the Common Shrimp (*Crangon vulgaris*) is the representative, the carapace, or shield covering the united head and chest, is of flattened shape, and the rostrum or beaked projection in front is also compressed. The second and third pairs of legs are of slender make, the fourth and fifth pairs being the stronger members. The abdomen is large and horny, and the outer antennae have a plate-like structure at their bases. These little animals inhabit the sand of many parts of our coasts in myriads, and are caught for the market by means of a bag-net placed transversely on a pole, and which is pushed through the sand at a depth of about 1½ feet. Large quantities are in this way captured as they dwell amid their native sand. The shrimps burrow swiftly in the sand by means of their hinder legs, which throw the sand forwards, whilst after they have succeeded in making a hole the antennae are used to fling back the sand in the further work of excavation. The shrimp may be distinguished at once from the equally familiar prawn (which see) by the fact that the rostrum or beak of the carapace in the latter is long and has toothed or serrated edges. The colour of the shrimp closely resembles that of the sand in which it lives, but on being boiled the shell assumes a reddish hue. Other species of the genus *Crangon* are the Banded Shrimp (*C. fasciatus*), Bell's Shrimp (*C. sculptus*), and the Spiny Shrimp. The first-mentioned species derives its name from the presence of a brown band of colour which marks the fourth ring of the abdomen, which is composed of narrow, rounded segments. It averages 1 inch in length. The Spiny Shrimp possesses five rows of tooth-like projections on its carapace; its colour is brown, marked above with dull white, and below with crimson spots. Bell's Shrimp is of very small and almost minute size, averaging from ¼ to ½ inch in length. Its colour is a brownish hue, streaked or spotted with chestnut and black. The carapace is faintly marked by tooth-like projections as in the spiny species.

The neighbouring family Alpheidae includes several species of shrimps, some of which (genus *Alpheus*) occur on British coasts, whilst one species, the *A. brevirostratus* of Japan, or the Short-beaked Red Shrimp, as it is termed, is a typical representative of the group. In this genus the carapace projects in front like a hood, and the rostrum is small or may be wanting altogether. The first and second pairs of legs are clawed. Most of the species of this genus inhabit the northern seas. The Scarlet Shrimp (*A. affinis*) of the Channel Islands and elsewhere, and the Red Shrimp of Edwards (*A. ruber*), found chiefly in the stomachs of northern cod-fishes, are also good

examples of the division. An allied genus, *Athanas*, includes Montague's Shrimp (*A. nitescens*) of the southern British coasts; a species of dark-green colour, and possessing large chelæ or pincer-like claws.

Belonging to the Crustacean order Amphipoda, and allied to the Sand-hoppers, we find the so-called 'Fresh-water Shrimp' (*Gammarus pulcx*, see Plate CRUSTACEA, fig. 19) of streams and brooks, distinguished as a genus by the slender upper antennæ, by the tufts of spines on the tail, and by the first and second pairs of legs possessing small nippers. The name 'shrimp' has been applied to this form from its rough resemblance to the familiar marine shrimps. This well-known little creature (about  $\frac{1}{2}$  inch long) swims actively on its side.

In the order Stomapoda the Locust or Mantis Shrimp (*Squilla mantis*, see Plate CRUSTACEA, fig. 18), Glass Shrimps (*Erichthys*), and Opossum Shrimps (*Mysis*) are included. The former species is so named from its somewhat resembling in outward appearance and habits the Mantis insect. In the family Squillidæ, to which the Mantis Shrimp belongs, the body is flattened, the first pair of legs being largely developed, as in the insect, and adapted for prehension. The carapace is long in the genus *Squilla*, and covers or shields the mouth and appendages. It is trilobular, or divided into three lobes. The abdomen is long, and very plainly jointed, with its terminal segments divided. These shrimps are very voracious, and of active habits. They mostly inhabit deep waters. The Gouty Shrimp (*Squilla chiroagra*) is allied to the Mantis Shrimp, and derives its fanciful name from the swollen appearance of the joints of its limbs. It is found at Mauritius. The genus *Caprella* (of which the *C. linearis* is a good example, fig. 21 on above plate) belongs to the order Læmodipoda; and the species just mentioned is sometimes also popularly known by the name 'Mantis Shrimp,' although of lower organization, much smaller size, and entirely different aspect from the true Mantis or Squilla.

The Opossum Shrimps (*Mysis chameleon*) belong, with the Mantis, to the order Amphipoda. They derive their popular name from the last pair of feet forming a structure which in both sexes exists as a pouch, but which in the females is largely developed, and serves for the purpose of carrying the ova or eggs. The Opossum Shrimps are common around our coasts, and are sometimes named Chameleon Shrimps. A species of *Mysis* (*M. relicta*) inhabits fresh-water lakes in Sweden and North America. *Mysis æneus* of the northern seas forms a large proportion of the food of the salmon during its term of sea existence in July and August. The Glass Shrimps, of which the *Erichthys vitreus* and *E. armatus* are good examples, also belong to the Amphipoda. These creatures are so named from the transparent nature of their bodies. They inhabit the Atlantic seas. The carapace is specially developed in front, the beak being very large and prominent.

More curious in habits perhaps than any of the other 'Shrimps' are the Brine Shrimps, forming the genus *Artemia*. One species, *A. gracilis*, occurs in the Great Salt Lake of Utah and other lakes of the Great Basin; and another, *A. salina*, is found in brine-pools in Britain. It has been found possible to transform *A. salina* into other species of its genus by altering the salinity of its habitat, and it has even been made to approximate to a fresh-water genus by greatly diminishing the proportion of salt in the water inhabited by it. *Artemia* belongs to the Crustacean order Phyllopoda, as also do the elegant little Fairy Shrimps (*Chirocephalus diantha-*

*nus*), which occur in fresh waters, and present such transparency of body and elegance of movements that it requires some tact to recognize them as they swim swiftly on their backs through the water. See also PODOPTHELMATA, PHYLLOPODA, STOMAPODA, &c.

SHROPSHIRE, or SALOP, an inland county of England, bounded on the north by Cheshire, the detached part of Flintshire, and a corner of Denbighshire; west by the latter county and Montgomery and Radnor; south by Hereford and Worcester; and east by Stafford. Area, 861,802 acres. The surface is extremely varied—in some parts rugged and mountainous, in others comparatively level. The highest summits attain elevations of from 1000 to 1732 feet above sea-level. The county is drained by the Severn and several of its tributaries. The new red sandstone occupies the whole northern portion and the old red sandstone a considerable part of the southern division. Another portion is composed of the stratified rocks of the Silurian and Cambrian systems. Archæan rocks are also represented. The principal mineral products are iron, coal, lead, limestone, and freestone. The coal-fields are extensive and productive. The soil is various, but generally fertile, and is on the whole well cultivated, although there are extensive tracts of waste land, and considerable portions of the elevated districts are too barren or rugged to admit of cultivation. About 135,000 acres are under corn crops, chiefly barley, wheat, and oats. Green crops are cultivated on about 55,000 acres, turnips being much the most important in this section. Considerably more than half is in permanent pasture. Woods and plantation occupy some 50,000 acres. In the south and west, cattle-breeding and dairy-farming are carried on to a considerable extent. The county is famous for its breed of sheep. A good deal of cheese is made, and large flocks of turkeys are raised. The manufactures include that of iron to a very great extent, china-ware, carpets, gloves, and flannel. Shropshire returns four county members to Parliament, the divisions being Oswestry, Newport, Wellington, and Ludlow; the only parliamentary borough is Shrewsbury. The municipal boroughs of the county are Shrewsbury, Wenlock, Oswestry, Bridgnorth, Ludlow, and Bishop's Castle. Pop. in 1881, 248,022; in 1891, 236,339; in 1901, 239,321.

SHROUDS, a range of large ropes extended from the heads of the lower masts to both sides of a ship, for the purpose of supporting the masts and enabling them to carry sail, &c. Small lines called *ratlines* traverse the shrouds horizontally from the deck upwards at distances of about 15 inches apart, so as to form a series of steps like the rounds of a ladder.

SHROVE - TUESDAY (from Anglo-Saxon, *scrifan*, to confess), the day before the first of Lent or Ash-Wednesday, so called because on that day it was customary for all persons to confess their sins. (See CARNIVAL and LENT.) It was the custom after having made confession, or been 'shriven,' to spend the remainder of the day in all kinds of amusement, football and cock-fighting taking the lead. The eating of flesh, however, was forbidden, and from the common practice of eating pancakes the day afterwards came to be commonly denominated *Pancake Tuesday*. This season received other designations, as *Fasting-tide*, *Fastens*, and *Fast-mass*, which are yet prevalent in some parts of England. Shrove-Tuesday is called in German *Fast-nacht* (fast eve), and in French *Mardi gras* (fat Tuesday).

SHRUB, a liqueur, consisting of lime or lemon juices and syrup, with the addition of a small quan-

tity of rum or other flavouring material. It is made chiefly in the West Indies.

**SHRUBS, INJURY TO.** See **PLANTATION.**

**SHUMLA** (Bulgarian, *Sumen*), a town in the Principality of Bulgaria, in an extensive basin inclosed by lofty hills of the Balkan range, 185 miles N.N.W. of Constantinople, and 56 miles west of Varna. These hills, which are generally very steep, form a kind of natural ramparts, to which much additional strength has been given by a series of outworks. In this way the heights around Shumla form an entrenched camp which, if at all defended, cannot easily be forced, but which at the same time, from its extent, requires a very numerous force to defend it. The nearer approaches to the town are protected by several strong redoubts and batteries, and also by a citadel. There is little in the town itself to attract much attention. It is for the most part indifferently built, but has a large square, usually the scene of much activity, several handsome mosques, beautiful baths, large barracks, and the magnificent mausoleum of the Grand-vizier Djazzar-Hassan-Pasha. It is the residence of a Greek archbishop; has extensive manufactures of copper wares, ready-made clothing, silk goods, slippers, and leather; and a good trade. The Russians unsuccessfully attempted its capture in 1774, 1810, and 1828, but they occupied it in 1878. Pop. (1900), 22,928.

**SHUSHA**, a town and fortress of Asiatic Russia, in Transcaucasia, in the government of Elisabetpol, and 120 miles distant from the town of Shemakha. It was founded under the name of Penah-abad by Nudir Shah, and occupies a strong position on a mountain which is accessible only on one side. Pop. (1897), 25,656.

**SHUSTER**, a town of Persia, in the province of Khuzistan, on the left bank of the Karun, here crossed by a long and ancient bridge, 170 miles west by south of Ispahan. It is surrounded by a wall of unburned bricks, flanked with towers and defended by a castle. Once a flourishing provincial capital, it lost much of its importance from plague and other causes, but is again rising owing to its position on the Karun, which has been opened to external commerce and is well adapted for steam navigation from its mouth to the neighbourhood of this place. Pop. 27,000.

**SHUTTLE**, the instrument used to carry the weft-thread in weaving. See **WEAVING.**

**SIAM**, a native state on the east side of Sumatra, extending from the mountains of the interior to the Straits of Malacca. It is ruled by a sultan, but is in a state of semi-dependence upon Holland. The capital, also called Siak, on the river of same name, has a considerable trade, both inland and foreign.

**SIAM** (native name, *Muang-Thai*, 'State of the Free'), an independent kingdom of south-eastern Asia, bounded on the west and north-west by British territory (Burma); on the east, north-east, and south-east by French territory (Tongking, Anam, and Cambodia); and on the south by the Gulf of Siam. The boundary on the north-west was delimited in 1891, and in 1893 the Mekong river was made the boundary on the French side for a considerable distance. France also has the right to erect stations on a certain portion of the west bank of the Mekong. The integrity of the kingdom was provided for by an Anglo-French agreement concluded in 1896. The total area of the country, within the boundaries latterly fixed, is about 244,000 square miles, of which about one-quarter is in the Malay Peninsula. The population is very imperfectly known, and the estimates vary between wide

extremes. The population of Siam within its present limits may be about 6,000,000.

The surface of the country is mountainous in the north, the mountains being branches of the great Himalaya system; the north-eastern and eastern parts are still very imperfectly known. Southward, the country consists of a vast plain. Off the coasts at a distance of 10 or 15 miles are numerous islands, mostly rocky, and considerably elevated. There are, besides numerous small rivers, two great navigable streams—the Menam or Meinam, and the Mekong. Of these the Menam is the most important, as intersecting the greater part of Siam proper, and almost monopolizing its trade and navigation. It rises by two chief branches in the Lao country in the north of the kingdom, has an estimated course of 800 miles, and falls into the Gulf of Siam by three channels 18 miles (in a direct line) below Bangkok. All the Siamese rivers are flooded between June and September, and to this circumstance is mainly due the fertility of their basins. The soil of the whole valley of the Menam is of great fertility, consisting of thick beds of alluvium from the yearly inundations of that river. The more mountainous parts are of sand and limestone, arid, uncultivated, or covered with forests. The climate of so extensive a country varies, of course, with the latitude and the elevation of its surface; but, as in other tropical countries, it has two seasons, the wet and the dry, the former beginning in April or May, and continuing till about the commencement of July, when the dry season sets in and lasts still the following April or May. The mean temperature at Bangkok is about 81°; maximum, 97°; minimum, 54°. On the whole the country is healthy, though in the wet season ague and cholera are prevalent.

**Minerals.**—Gold is extensively diffused, and is obtained in tolerable purity. Tin, iron, copper, and lead are abundant, and are wrought, especially the two former, on a large scale by the Chinese. Zinc and antimony are found to the east of the Menam. The sapphire, oriental ruby, and oriental topaz are found in the hills of Chantibun, on the east side of the gulf.

**Vegetation.**—Rice and maize are the grains most extensively cultivated in the country. Of the tropical farinaceous roots the Siamese raise the usual varieties, and among others the sweet-potato. Cocoa and areca palms are numerous, especially the former, in the lower districts; and the oil is extensively exported. No part of the East is more celebrated for the abundance and quality of its fruits. The mango, mangosteen, litchi, durian, pomegranate, guava, pine-apple, and, in short, all the fruits of South-eastern Asia, the Indian Islands, and tropical America, are abundant and of exquisite quality. The cultivation of the sugar-cane is carried on on an extensive scale. Black pepper of good quality, tobacco, and cotton of several sorts are largely produced. Cardamoms are plentifully obtained in royal preserves strictly guarded. Gamboge is yielded by a species of tree growing in the forests on the east coast of the Gulf of Siam, and in the Siamese portion of Cambodia (whence its name). In the same districts also are procured large quantities of scented agila or aloes wood, which is both much used by the natives and sent to the Chinese, who employ it for sacred purposes, and use it in their private and public temples. Sappan-wood is procured extensively from the forests between lat. 10° and 18°, and in point of quantity it forms one of the most considerable of the Siamese exports. Excellent teak-timber abounds in the forests of Upper Siam, and is much used in the construction of junks and temples.

**Animals.**—Among carnivorous animals are the

tiger and leopard, the bear, otter, the musk-civet, the cat and the dog, both wild and domestic. Porcupines, squirrels, rats, and mice are common. The pangolin is found in the forests; and its scaly skin is sold to the Chinese, who esteem it for its medicinal qualities. The orang-outang and other species of apes are pretty abundant. Among the ruminating quadrupeds are found seven species of deer, the sheep, goat, ox, and buffalo. The horses are of small size (under 13 hands), and are not much reared by the natives, those in use being principally procured from Yun-nan in China. The hog exists abundantly in the forests, and is domesticated by the Chinese residents. The single-horned rhinoceros is met with in unusual numbers, and is hunted for its hide and horn, both of which are exported to China. The principal boast of the Siamese, however, is in the high perfection of their elephants, which here attain a size and beauty elsewhere unknown, and are held in high esteem throughout India. A very great additional value is set on white elephants, evidently albinos, which, when captured, become the property of the king. Albino deer, monkeys, and even tortoises, are by no means uncommon in Siam. Among the birds the water-birds and waders are by far the most numerous; geese, ducks, boobies, cormorants, king-fishers, storks, and pelicans are frequent; the forests abound with peacocks, pheasants, and pigeons; and in the islands are large flocks of the swallows that produce the famed edible birds'-nests. Crocodiles, geckoes, and other kinds of lizards, tortoises, and green-turtles are numerous, the last of which, as well as their eggs, are in great request among the Siamese as an article of food, and from their sale add not inconsiderably to the royal revenue. The python serpent attains an immense size, and there are many species of snakes. The fish of the Menam are abundant, but of inferior quality. The only insect in Siam worthy of notice is the *Coccus lacca*, which produces the valuable dye and gum, the *lac* of commerce.

**Trade and Navigation.**—Siam has a most extensive trade, both inland and coastwise, as well as foreign. Every province of the kingdom produces some article in foreign demand; and Bangkok, from its situation on the Menam, has become the great centre of all its commerce. The principal articles brought down from the higher provinces are rice and paddy, cotton, teak-timber, rosewood, and sappan-wood, lac, benzoin, ivory, and bees'-wax; while the districts east and west of the Menam furnish gamboge, cardamoms, and sugar; the Malay provinces tin, zinc, cotton, &c. The foreign trade is conducted chiefly with China and more especially with Hong-Kong, British India, the United States, and Britain. The exports to Europe, carried on partly through Singapore and partly direct, comprise rice, teak, pepper, bullocks, gamboge, tin, cardamoms, ivory, horns and hides, with various minor articles;—the imports, all kinds of textile fabrics, iron and steel goods, earthen and glass ware, hardware and cutlery, opium, sugar, &c. In 1855 a commercial treaty was concluded with Siam by Great Britain, and since then there has been a great advance of trade. The total exports from Bangkok (mainly to Singapore and Hong-Kong) were valued in 1900 at £9,087,819, chiefly rice; the imports at £2,576,540, of which cotton goods made up £409,058, treasure £336,304, machinery, iron, &c., £169,346. Of British and foreign vessels there entered the port of Bangkok in 1900, 454, of 380,477 tons, of which 169 of 141,856 tons were British. The number of vessels cleared was 450, of 378,073 tons, of which 169, with a tonnage of 142,520, were British. There is a large importation into Bangkok of British goods transhipped at Singapore. For-

merly British predominance in the carrying trade of Siam was overwhelming, but other countries, such as Germany and France, have greatly improved their position in recent years. The chief money of Siam is the *tical* or *bat*, a silver coin the value of which is about 1s. 2½d.; the Mexican dollar, value 2s., is also common. Only silver and bronze coins are issued. The chief weights are the *chang* or *catty* = 2·675 lbs., and the *picul* = 50 changs.

**Arts, Manufactures, &c.**—The Siamese have made but little progress in the useful arts. House-carpentry, canoe and junk building, manufacturing pottery and coarse cutlery, leather-dressing, and the construction of musical instruments, are their chief mechanical employments. A few rude hand-loom are in operation, chiefly worked by women, but the fabrics, whether of silk or cotton, are of very coarse quality. Their domestic architecture is in an equally rude and backward state—the houses of the lower orders being formed wholly of wood or bamboo, roofed with palm-leaves, and mostly raised on piles, as in the rest of ultra-Gangetic India. A few only in the capital are built with brick and mortar. Many of their houses, too, are constructed on boats, which abound on the river near Bangkok; of the arch they are wholly ignorant. Roads there are none; and wheel-carriages are all but unknown. On their religious edifices, however, the Siamese bestow abundant labour and expense; these are constructed of solid masonry, and covered with tiles, having all the wood-work laboriously carved and gilded, and filled with carved and richly-gilt images of Buddha.

**Inhabitants, Religion, &c.**—The Siamese, in common with the Laos, Cambodians, and Malays, are members of the great Mongolian family, and of the same race as the people of Burmah and Anam. In stature they do not average more than 5 feet 3 inches in height; they have a lighter coloured skin than the western Asiatics, but darker than the Chinese. They are inclined to obesity, have large lower limbs, and stout long arms; yet they are by no means a strong or robust people. Their faces are broad and flat, with round prominent cheek-bones, a small nose obtusely pointed, and rather hollow at the bridge, a large mouth with rather thick lips, the lower jaw long and square at the back, small black eyes, a low forehead, and very scanty beard. Their hair is always black, thick, coarse, and lank, worn close by both sexes, except from the forehead to the crown, where it is about 2 inches long, and made to stand erect. They universally stain the teeth with an indelible black dye; and the better classes, like the Chinese, permit the finger-nails to grow to an enormous length. The Siamese are described as lively, timid, inconstant, servile, and indolent, but humane and charitable; a prominent feature in their character is their excessive national vanity, which exceeds even that of the Chinese. They are temperate and abstemious, by no means revengeful, obedient to the laws, and strongly attached by their domestic ties. Of the population it is estimated that 2,000,000 are Siamese, while the Chinese number 1,000,000, the Malays 1,000,000, and the Laos 2,000,000.

The Siamese profess Buddhism of a very degraded kind, introduced into the country about the middle of the seventh century. The moral code of the religion is comprised in five negative precepts—1, not to kill (which extends to animals, plants, and even seeds); 2, not to steal; 3, to commit no impurity; 4, not to tell falsehoods; 5, to drink no intoxicating liquors. Little attention, however, is paid to any of these, except by the priests, it being the business of the laity to sin, and of the *talapouts* not only to be holy themselves, but by their holiness to expiate the sins of the people.

*Language, Literature, and Education.*—The Siamese language is exceedingly simple in its construction, and forms a connecting link between the Chinese and Malay. The alphabet consists of forty-four consonants and twenty vowels (including semi-vowels and diphthongs), and is thus very rich in the vowel element. Siamese resembles Chinese in the importance given to tone, the same word having often several very different meanings according to the tone in which it is pronounced. The written characters seem to be derived from a form of Sanskrit. The roots are few in number—all monosyllabic; and there are no terminations to indicate gender (at least these are often dispensed with), number, person, mood, or tense. The literature is meagre, uninteresting, and in point of imagination and force of expression much below the Arabic, Persian, or Hindustani; the style is simple and literal, but by no means perspicuous. The Siamese have no histories of a trustworthy character, their works on medicine and law are full of ignorance and confusion, and those on religion and philosophy translations or mere compilations. They have some excellent fables, with very good dramas and other poems. Rhymes are very abundant in Siamese, and their poems are full of rhyming jingles and alliteration. The printing-press has been introduced in recent years, and many of the best Siamese works can now be had in a printed form. Education is carried to a very limited extent; few can do more than read and write awkwardly, and perhaps cast accounts.

*Government, History, &c.*—The government of Siam is that of an absolute monarchy, but has been carried on in a more enlightened fashion recently than was formerly the case. The king is considered almost in the light of a deity, and addressed as such, his most common designations being 'Sacred lord of lives', 'Owner of all', 'Most exalted and infallible lord', &c. The kingdom is hereditary; but the eldest son of the king does not necessarily succeed his father, who may nominate another to be his heir. The executive power is in the hands of the king, who is assisted by a cabinet consisting of the heads of the chief departments of state, and including the ministers of foreign affairs, the interior, justice, finance, war, public instruction, public works, &c. The legislative power is exercised by the king in conjunction with a legislative council consisting of the ministers of state and a certain number of other persons, the duty of the council being to revise, amend, and complete the legislation of the country. The council may appoint committees to deal with various subjects on which legislation is proposed; and it is even intrusted with the power of promulgating laws without the royal assent should the monarch be in any way disabled.

Siam appears to have no place in history prior to A.D. 638, and the credible records go back only to 1350, the date of the foundation of Ayuthia, the old capital, on the Menam, about 60 miles above its mouth. In 1612 an English ship ascended this river as far as Ayuthia, eight years after which the Portuguese sent thither their first missionaries. In 1689 Constantine Phaulcon, an enterprising Greek, became prime-minister, and introduced a respect for European customs and notions. Mutual embassies were at this period sent between Siam and the court of France, with which Phaulcon intrigued to bring about a revolution. This led to his downfall and death, as well as the expulsion of the French. Contentions for the throne distracted the country from 1690 till 1759; during which interval Alompra, the victorious ruler of Burmah, overran the whole valley of the Menam. The country was afterwards wrested from the Burmese by Pye-ya-tak or Phayatak, who

was of Chinese extraction, at the head of a number of natives. He planted himself on the throne, and with a view to commerce made Bangkok the metropolis, instead of Ayuthia. Being a cruel ruler he was murdered by his general Chakri, who himself seized the throne in 1782, and was the founder of the present reigning dynasty. Maha Mong-Kut, who ascended the throne in 1851, and died in 1868, was a man of science and energy, and largely promoted the material and moral progress of the country. Commercial treaties were made with England and France in 1855-56. He was succeeded by the present sovereign, Chulalongkorn, who has shown equal enlightenment, and in 1897 paid a visit to Europe, his travels including England, Scotland, and other countries. British and other machinery of various kinds has been latterly introduced. Europeans are employed in various capacities, and a number of young Siamese have been sent to Europe to make a personal acquaintance with western civilization. Gas-works have been constructed in Bangkok; there is a railway 70 miles long running inland from the capital, and others are being made or are projected.

SIAMANG (*Siamanga*, or *Hylobates syndactyla*), one of the higher Anthropoid or Man-like Apes. This form, the largest and one of the best known of the Gibbons, inhabits Sumatra. Its specific name, *syndactyla*, is derived from the fact that the middle and index toes of the hinder feet are united together as far as the nail or terminal phalanx or joint. The colour of the hair is black. It averages about 3 feet in height in its adult state. The arms, as in all the gibbons, are notable for their great relative length, the hands nearly or quite reaching the ground when these apes stand in the upright or semi-erect posture. No tail exists, but natal callosities are developed. Beneath the throat of the siamang a double sac or pouch exists, and under excitement of any kind these sacs become dilated, while some writers are of opinion that the cry of this ape is increased in resonance and intensity through the dilatation of these structures. The siamang appears to be inoffensive in its disposition, and except when provoked does not retaliate injury. It may exhibit a high degree of intelligence, and has been known to attach itself especially to its master or keeper. Like the others of its genus the siamang leads an essentially arboreal life, the length of limb giving to the ape a dexterity among trees that few other monkeys possess.

SIAMESE TWINS, the name applied to two individuals (forming what in physiological language is known as a 'monster'; see MONSTROSITY) born in Siam. These two males were united together so as to form a 'double monster', and from their mode of connection were regarded as examples of 'anterior duplicity'. They were born in May, 1811, their parents being of Chinese extraction. Their respective names were Eng and Chang. Nothing unusual was recorded in the history of their birth; and their mother observed, that she suffered no greater inconvenience at their birth than at that of her former children, as they were very small, and the head of one was presented between the legs of the other. Their parents were of the poorer class, and until the youths left their home they were engaged in fishing, manufacturing cocoa-nut oil, keeping poultry, &c., for the support of the family. They were about 5 feet 2 inches in height, well made, and muscular. They have been known to carry a person weighing 280 lbs. 100 feet. They were agile, could walk or run with swiftness, and could swim well. Their intellectual powers were acute: they played at chess and draughts remarkably well. Their feelings were warm and affectionate, and their conduct amiable and well regulated. They never entered into conversation

with each other beyond a simple remark made by one to the other, which seems to be rationally accounted for by the fact that their experience being all in common, they had nothing to communicate. The attempt was frequently made to engage them in separate conversations with different individuals, but always without success, as they were invariably inclined to direct their attention to the same thing at the same time. In their movements perfect equanimity was observed, the one always concurring with the other, so that they appeared as if actuated by a common mind. In their employments and amusements they were never known to utter an angry word towards each other. Whatever pleased or displeased one had the same effect on the other. They felt hunger and thirst at the same time, and the quantity of food taken by them was as nearly alike as possible. Both felt the desire to sleep simultaneously, and they always awoke at the same moment. Eng was physically, and Chang mentally the stronger of the two.

In April, 1829, they were brought from Siam to America, and were exhibited in the United States, and afterwards throughout Europe, during 1829 and the three subsequent years. Their history and formation attracted, as might be supposed, very great attention, particularly from physiologists and medical men, and many speculations were hazarded as to the feasibility, propriety, and success of an operation destined to separate them; but although advised by some eminent authorities that such a proceeding would be quite justifiable and probably successful, the twins refused to allow the operation to be performed, and they thus lived and died in their connected state. They ultimately took up their residence in America, and married two sisters. Each twin had several children by his respective wife. They made several visits to Europe for the purpose of exhibiting themselves, and amassed a considerable sum of money. They settled in the United States as farmers at Mount Airy, some distance from Philadelphia, from which town a scientific commission proceeded after their death to investigate their curious case.

It is interesting to note several of the opinions expressed by those who examined the Siamese twins during life, and to compare these views with the results of the *post mortem* examination, which tended in some cases to confirm the opinions of several physiologists. Thus Dr. Warren of the United States wrote of them—'The substance by which they are connected is a mass 2 inches long at its upper edge, and about 5 at the lower. Its breadth, from above downwards, may be 4 inches, and its thickness, in a horizontal direction, 2 inches. Of course it is not a rounded cord, but thicker in the perpendicular than in the horizontal direction. At its lower edge is perceived a single umbilicus, through which passed a single umbilical cord to nourish both children in the fetal state. Placing my hand on this substance, which I will denominate the cord, I was surprised to find it extremely hard. On further examination this hardness was found to exist at the upper part of the cord only, and to be prolonged into the breast of each boy. Tracing it upwards I found it to be constituted by a prolongation of the ensiform cartilage of the sternum or extremity of the breast-bone. The breadth of this cartilage is an inch and a half; its thickness may be about the eighth of an inch. The cartilages proceeding from each sternum meet at an angle, and then seem to be connected by a ligament, so as to form a joint. This joint has a motion upwards and downwards, and also a lateral motion, the latter opening in such way that when the boys turn in either direction the edges of the cartilage are found to open and shut. The lower face of this cartilage is concave, and under it is felt a rounded cord, which

may be the remains of the umbilical cord. Besides this there is nothing remarkable felt in the connecting substance. I could distinguish no pulsating vessel. The whole of this cord is covered by the skin. It is remarkably strong, and has no great sensibility, for they allow themselves to be pulled by a rope fastened to it without exhibiting uneasiness.' In 1830 (April 1) Mr. G. B. Bolton remarked, at a meeting of the Royal Society of London, that 'under the cartilage, while they stand in their ordinary posture, are large hernial sacs opening into each abdomen, and into which, on coughing, congenital hernias are forced, probably in each boy, formed by a portion of the transverse arch of the colon. Generally, however, and under ordinary circumstances, these hernias are not apparent. Whether there is a communication between the two abdominal cavities, or a distinct peritoneal sac belonging to each hernia, is by no means obvious. When these hernias protrude, their respective contents are pushed forwards as far as the middle of the band.' If the connecting-link was touched in the centre, the touch was equally felt by both; but at  $\frac{1}{2}$  inch from the centre it was felt by but one. A spleen, sweetbread, or pancreas, and stomach existed in each body, and the lungs and urinary organs were also separate. When exhibited the twins were not exactly opposite each other, but stood obliquely side by side. They could not remain for any length of time face to face, and according to Dubois their bodies acquired an oblique attitude, and they also moved in an oblique fashion. 'The consequence of this,' the latter authority remarked, 'was, that the right limb of the one and the left of the other individual were the principal organs of movement; and that the intermediate limbs, that is to say, the left of the one and the right of the other, remained merely passive. When either of them coughed, the bond of union swelled up in its whole length, proving that they had but one peritoneal cavity, of which a transverse prolongation passed through the connecting medium.'

Chang died on January 17, 1874. He had, about three years previously, had a paralytic stroke, which occurred when they were crossing the Atlantic, being seven days out from Liverpool. Chang had been intemperate for some time prior to this paralytic seizure, and was frequently intoxicated whilst on board the vessel. When Chang was drunk Eng was not affected. Previously to Chang's death he had suffered much from a violent cough; and although advised against going out by his medical attendant, he persisted in going to the house of his brother two days before his death. Eng was asleep when Chang died, and on awakening and learning that his brother was dead, he said to his wife, 'I am dying.' He rubbed his limbs, became restless, and then complained of a choking sensation. He took no notice of his dead brother save to draw his body nearer to himself. Eng was in perfect health on going to bed, and from the fact that Chang had been dead for some time prior to Eng's awaking, it must be inferred that the death of the one twin had produced little physical impression on the other. After being told of the death of his brother, however, Eng became markedly affected, and soon died. The cause of Chang's death was a cerebral clot, whilst Eng was believed to have died from heart disease aggravated by the mental shock sustained on hearing of his brother's death.

According to the report of the medical men who examined the bodies after death, the band connecting the twins was 4 inches long, and 8 inches in circumference. The peritoneum or lining membrane of the abdominal cavity extended into the band from each twin, but the peritoneal cavities themselves were distinct and separate at the median line. The twins

were also united above by the union or fusion of their ensiform cartilages—the lower or cartilaginous portions of their breast-bones. On throwing an injection into the portal circulation of Chang, the fluid was found to appear in that of Eng, thus proving that a vascular connection undoubtedly existed. The surgical anatomy of the connecting band, we are told, consisted in the skin and fascia which cover it: in the two peritoneal pouches or prolongations, one from each twin, which meet in the middle; in the large peritoneal pouch; in the vascular connection or that between the blood-vessels of the twins; and in the remains of the hypogastric arteries which were found in the lower portion of the band. The chief difficulties, therefore, which would have presented themselves to the surgeon who would have attempted section of the band, would have consisted in the presence of the peritoneal processes, and in the connection between the portal circulations. But at the same time, when operations such as those of ovariotomy and gastrotomy, which interfere with the peritoneum, are fearlessly performed by surgeons in the present day, the mere presence of this membrane in the band would not of itself have rendered the operation unjustifiable. It is noteworthy that when pressure was made upon the band during the life of the twins by a surgeon, they fainted. Great stress was laid by the medical men who examined them on the connection already mentioned between the livers of the twins, to which connection the term 'tract of portal continuity' was applied.

**SIBERIA, or RUSSIA IN ASIA**, a large section of the Russian Empire, which, speaking roughly, occupies the whole of Northern Asia above lat. 50° N., and between lon. 60° and 190° E., and in the south-west extends as far south as the parallel of 40°, comprehending all the Russian territory in Asia except Transcaucasia. It is bounded north by the Arctic Ocean, east by the Sea of Kamtschatka and the North Pacific Ocean, south by the Sea of Okhotsk, the Chinese territories, and Independent Tartary, and west by Russia in Europe; greatest length, from west to east, about 3600 miles; greatest breadth, about 2200 miles. The total area of Siberia proper, including Sakhalin, is 4,833,496 square miles. Since the extension of the Russian dominions in Central Asia a territorial division called Central Asia has been formed, partly taken from what was formerly Siberia, and partly formed of newly-acquired territory. Siberia, strictly so called, is therefore of smaller extent than formerly. The administrative divisions of the whole territory, with their separate population, are exhibited in the following table:—

	Area in English sq. miles.	Pop. 1897.
<b>PROVINCES—</b>		
Littoral (coast province)....	715,982	220,557
Amur .....	172,848	118,570
Yakutsk .....	1,533,397	261,731
Transbaikal .....	236,868	664,071
<b>GOVERNMENTS—</b>		
Irkutsk .....	287,061	506,517
Yeniseisk .....	987,196	559,902
Tomsk .....	831,169	1,929,092
Tobolsk .....	539,059	1,438,484
Total for Siberia proper	4,804,160	5,698,924
CENTRAL ASIA .....	1,548,825	7,721,684
Total .....	6,352,985	13,420,608
Add the island of Sakhalin, area 29,336 sq. miles; pop. (1897), 28,166.		

The portion of this immense territory in the extreme south-west is partly below the level of the ocean, and is drained either into the Caspian or (by the Amoo Daria and Sir Daria) into the Aral. A large part of this region is desert, and the soil is frequently impregnated with salt. The remainder of the Russian

territory, though comprising the whole of Northern Asia from west to east, has much less diversity of surface than might be presumed from its extent. Assuming the meridian of 105° as a line of demarcation, two regions will be formed—a western and an eastern, exhibiting a very marked difference in the configuration of their surface. Both regions have their greatest altitude in the south, and may be considered as a vast inclined plane, sloping gradually north to the Arctic Ocean; but the eastern region is traversed in different directions by several mountain-regions, whereas the western region, with the exception of the chain of the Ural on the western, and that of the Altai on the southern frontiers, forms a vast plain, almost unbroken by any greater heights than a few hills and the banks of the rivers which wind across it. This plain, towards the south, has a height of about 2000 feet above the sea, but towards the north is so near its level as often to become extensively inundated. For convenience of description it has been arranged, according to its productive powers, in four divisions—the steppe or pastoral, the agricultural, the woody, and the moorland or tundra. The steppe, occupying the most elevated part of the plain, extends from the southern frontiers north to lat. 55°; and from the western frontiers, within these limits, east to the banks of the Irtysh. The greater part of it consists of what is called the Steppe of Ishim, and has a bare and almost sterile surface, often incrustated with salt, but also occasionally covered with a scanty vegetation. The agricultural division extends northwards to about lat. 60°. In many parts, where it borders on the steppe, it has much of the same character, and has only occasional tracts which have been or can be advantageously brought under the plough; and in many other parts primeval forests are often found. The division thus named has an extent more than double that of the British Islands, and under favourable circumstances might furnish subsistence to a very large population; but as yet it is only the more fertile alluvial tracts adjacent to the rivers that have been brought under anything like regular culture. Within this division, though not properly belonging to it, is the Steppe of Baraba, situated between the Irtysh and the Obé. It has a more abundant vegetation than the Steppe of Ishim, which it otherwise resembles, and in its northern portion is covered with nearly continuous forests of birch and fir, haunted by numerous wild animals, including the beaver. From this the wooded division extends northward to lat. 64°, and in parts to 66°, though in the higher latitude the trees are seldom of very vigorous growth. The whole of this division is covered with vast forests of birch and different species of fir and pine. The population, few in numbers, are settled chiefly on the banks of the Obé and Yenisei, and live mainly on game and fish; the latter, including salmon, sturgeon, and herrings, ascending from the sea as far as the confluence of the Tom. Wild animals also are very numerous, and many valuable furs are obtained. The last division is that of the moorland or tundra, consisting of a low monotonous flat covered with moss, and nearly destitute of trees. It extends along the shores of the Arctic Ocean, and has so rigorous a climate that even in summer ice is found a few inches below the surface. Here the reindeer exists in vast herds, both wild and domesticated; white bears and foxes are also numerous, and furnish valuable furs; and the coasts and mouths of the rivers are frequented by immense shoals of fish and flocks of fowl.

Siberia to the east of lon. 105°, forming nearly one-half of the whole territory, has a much more diversified surface than the western region, and owing partly to its general ruggedness and elevation, and

partly to the greater severity of its climate, has much less land adapted for agricultural purposes. The Sea of Okhotsk has a bold and rocky shore, and the country behind rises with a steep ascent till a mountain-range is formed, with a general altitude of nearly 3000 feet above sea-level. This range, under the name of the Stanovoi Mountains, runs nearly parallel with the coast till it reaches the frontiers of China, where it takes the name of the Jablonnoi Mountains, and proceeding west continues for a long distance to form the boundary between the two empires. It then takes the name of the Mountains of Daouria, and throws out numerous ramifications, which, continuing west, throw their arms round Lake Baikal, and cover almost all the south part of the government of Irkutsk. Other ramifications, proceeding north, form the water-sheds of the numerous affluents of the right bank of the Lena. On both sides of this river the surface continues elevated, and forms a table-land, the interior of which is still very imperfectly known. The best portions of Eastern Siberia occur in the south of the government of Irkutsk, where, in the lower and more open valleys in the vicinity of Lake Baikal, cultivation has been attempted with success, and the oak and hazel, unknown in other parts of Siberia, are found growing freely. In almost the whole of the same government, where the configuration of the surface does not present invincible obstacles, all the grains of Europe are grown, and even the mountains and hills are covered during the greater part of the year with good pasture. Still farther north, in the government of Yakutsk, as far as the town of same name, corn is cultivated in patches in the upper vale of the Lena, though the far greater part of it is covered with fir and pine. The north part of Eastern Siberia consists of two distinct portions, the one extending from lon. 105° E. to the lower valley of the Lena, and the other from that valley east to Behring's Sea. The former portion is very imperfectly known; the latter, as far as the Kolyma, is traversed from north to south by chains of low hills, separated from each other by wide valleys or open plains, and generally overgrown with stunted larch and birch. In these valleys and plains are numerous lakes, generally well supplied with fish, and bordered by low banks, on which a rich grassy sward is often seen. To the east of the Kolyma branches from the Stanovoi Mountains stretch north, and form a series of ranges which frequently rise from 2000 feet to 3000 feet. Some of these penetrate to the north coast, and are seen forming precipitous cliffs at Shelagskoi Nos, Cape North, and other headlands. Other ramifications from the Stanovoi pursue an opposite course, and traverse the remarkable peninsula of Kamtschatka almost centrally to its southern extremity.

*Rivers.*—These are both numerous and of great magnitude. From the configuration of the country they almost all flow in a northerly direction, and belong to the basin of the Arctic Ocean. The chief exceptions are the Anadir and the affluents of the Amur in the east, and the Sir Daria, Amoo Daria, and other streams in the south-west. The great rivers belonging to the basin of the Arctic Ocean flow for the most part through immense tracts of level country, and hence are remarkable at once for the length of their course, the volume of water which they accumulate from numerous and important affluents, and the few obstacles which they present to a continuous navigation. The advantages which they offer in the latter respect are diminished by the long period during which they are frozen over; but even then they do not cease to be available for traffic, and become, in fact, the great highways of the country. The Obe is one of the largest rivers of the Old World;

the length of its course is 2400 miles, and the area of its basin is 1,224,435 square miles. Among its important affluents, many of them so large as to be entitled to rank as magnificent rivers, are the Irtdish, Ishim, and Tobol, which, by uniting their streams, more than double its volume; the Tom, Tchulin, and Ket. The estuary of the Obe forms a gulf from 70 miles to 80 miles wide, and above 400 miles long. Large quantities of fish are taken in this river and its tributaries. The Yenisei, the second river in importance, draws its waters from an area of not less than 1,020,000 square miles. The length of its course, if measured from the commencement of the Selenga, its remotest tributary, exceeds that of the Obe by 100 miles. Its most important affluents are the Selenga, which, before entering Lake Baikal, drains an area of more than 140,000 square miles; the Angara, which receives the discharge of the lake, and in the lower part of its course takes the name of Upper Tunguska; the Middle Tunguska, and the Lower Tunguska. The estuary of the Yenisei is about 20 miles wide, and 200 miles long. The Lena has a course of about 2000 miles, and drains an area of about 800,000 square miles. It rises hardly 20 miles to the west of Lake Baikal, and becomes navigable at 50 miles from its source. Its principal affluents are the Vitim, which has a course of 700 miles, of which a considerable part is navigable; the Olekma, which flows 500 miles through interminable forests; the Aldan, which drains an extensive tract of table-land between lon. 125° and 140° E.; and the Viliui, which rises in a mountainous district not far from the Lower Tunguska, and flows west for about 600 miles. The most important of the minor rivers which send their waters directly to the Arctic Ocean are the Olenek, between the Yenisei and Lena; and to the east of the latter, the Indighirka and Kolyma. The only important lakes are those of Baikal in the government of Irkutsk, the Sea of Aral, and Balkash-Nor or Tenghiz, in the south-west. Numerous other lakes are scattered over the surface, and more especially in the tundras, where whole chains of them, covering extensive tracts, not unfrequently occur.

*Geology and Minerals.*—The geology of Siberia is very imperfectly known. Granite and crystalline schists are found chiefly on the eastern slopes of the Ural Mountains, in the south among the mountain-ranges of the Altaï as far north as lat. 57° N., and between lon. 85° and 120° E., chiefly in the governments of Tomsk and Irkutsk, on both sides of the Upper Tunguska and east of the Yenisei; in the upper part of the basin of the Middle Tunguska; and in the very eastern extremity of the country, from lon. 165° to the shores of Behring's Strait. The volcanic rocks belong mostly to the tertiary period, and are found chiefly in the south, in connection with the granite and crystalline schists above described. They compose the great mass of the mountain-range which skirts the western shores of Lake Baikal, and are seen in a still more magnificent and interesting form in the mountains which proceed from north to south, nearly through the centre of the Peninsula of Kamtschatka, where are several active volcanoes. Palaeozoic rocks, including under the designation rocks belonging partly to the Silurian, partly to the Devonian, and partly to the carboniferous systems, are developed chiefly in the south, where they occupy a large space in the form of a triangle, the apex of which is at the town of Irkutsk, and the base on the parallel of 60°, between lon. 85° and 120° E. Another large development of the same rocks is seen on the north-west and north of the Sea of Okhotsk, and to a considerable distance inland. Secondary rocks higher in the series than the

carboniferous system commence near the northern shores of Lake Tenghis, and stretch northwards, occupying a considerable tract on both sides of the upper valley of the Irtysh; a more partial development of the same rocks is seen on the north of the Obe, commencing near the confluence of the Ket, and extending north in a comparatively narrow belt to the sources of the Taz. But by far the most extensive formation in Siberia is the tertiary, which stretches almost continuously from the last slopes of the Ural Mountains east across the Obe to the valley of the Yenisei; and in other quarters, though more intermingled with earlier formations, covers no inconsiderable portion of the whole surface. The shores of the Arctic Ocean, almost throughout their whole extent, and to a considerable distance inland, have a deep alluvial covering, remarkable for containing deposits of fossil elephants and other animals in such quantities that the ivory obtained from them forms an important article of commerce. The minerals of Siberia are evidently of immense value, and though the real extent of surface on which they are found is as yet only roughly guessed at, there cannot be a doubt that the most precious of all the metals exists there in greater abundance than in any other part of the Old World. Till recently the auriferous deposits were supposed to be almost confined to the eastern slopes of the Ural Mountains, and to occupy a zone extending over from 5° to 6° of latitude to the north and south of Ekaterinburg; but it has been discovered that some of the eastern regions, particularly in the governments of Tomsk and Yeniseisk, are highly auriferous, and that a tract larger in area than the whole of France contains gold, not in its alluvia, but in the very matrix of its rocks of palæozoic schists and limestones, which, when pounded and analyzed, are found to be more or less impregnated with gold. The principal mining districts are those of the Ural already mentioned, the Altai, and Nertchinsk, in the basin of the Amur. Besides gold iron, copper, silver, platinum, lead, tin, and zinc are found in greater or less abundance. The other minerals of Siberia deserving of notice are the emerald and topaz, of which there are celebrated mines at Nertchinsk; salt, found in natural crystals on the banks of lakes, chiefly in the steppes of Ishim and Baraba; jasper and porphyry of great beauty, quarried especially in the valley of the Charysh among the Altai Mountains; lapis-lazuli, found among the mountains in the vicinity of Lake Baikal; diamonds, found occasionally on the eastern slopes of the Ural Mountains; malachite, obtained in greater or less quantity from all the mining districts, containing copper; and mica, in the form of large plates, extensively used as a substitute for glass, and found in greatest abundance on the banks of the Vitim.

*Climate.*—This country is remarkable for its rigour. The isothermal line which skirts the southern coast of Iceland, in proceeding east, descends rapidly till it reaches St. Petersburg, and then more gradually till it reaches lon. 100° degrees E., where it is found in lat. 52°. From this it proceeds nearly due east, passing through the southern part of Lake Baikal, the town of Nertchinsk, and the southern extremity of Kamtchatka. It thus appears that the southern coast of Iceland, in lat. 63°, has the same mean temperature as Eastern Siberia in lat. 52°; in other words, that in proceeding from west to east the cold increases so much as to make places in the same latitude as Berlin to have a climate nearly as cold as Iceland. In the same manner the line of permanent ground-frost descends in parts of Siberia as far south as lat. 56°, nearly the same as that of Edinburgh; and over the whole country to the east of the Ural Mountains is as low as lat. 60°. Erman found that

annually between 17th December and 18th February, and most frequently in the first three weeks of January, cold is experienced exceeding 90° Fahr. below the freezing-point; and that for two entire months, or one-sixth part of the whole year, mercury is a solid body. This extreme winter is succeeded by an exceedingly warm summer. Thaw usually commences on the 1st of April, and the temperature increases rapidly till it attains its maximum in July. In this month the average height of the thermometer is about 66° Fahr., but it not unfrequently rises in the shade above 77°. In Yakutsk, where the cold is severest, notwithstanding its long and extreme winter, there are 128 days in the year without frost; and within that period several kinds of grain, not excluding wheat, have time to attain maturity; and in rich alluvial soils often produce a return of fifteen-fold.

*Manufactures, Trade, and Towns.*—The manufactures are very limited, and are confined for the most part to a few of the larger towns, where government factories have been established. The more important articles are leather, earthenware, porcelain, glass, and hardware. In some places, as at Telma, large woollen and linen factories employ a considerable number of hands, chiefly exiles, in weaving woollen and linen cloth, and in conducting all the previous processes of preparing the wool, flax, &c. The trade is of considerable extent; and in so far as confined to the produce of the country consists chiefly of cattle, fish, caviar, furs, skins, and metals. A very important transit trade is also carried on across the country between Russia in Europe and China. From the latter country by far the most important article is tea, both in the dried leaf and in the form of cakes or bricks. The greater part of the latter is disposed of to the nomadic tribes, and a very large proportion of the former never passes beyond the limits of Siberia, but is retained for home consumption. Other articles of importance from China are coarse cotton stuffs, rhubarb, silks, satins, &c. The chief mart for this trade is the town of Kiachta. For the interior traffic the rivers naturally furnish the most important conveyance; but when these become closed with ice other means of conveyance must be resorted to, among which the most characteristic is that of sledges drawn by reindeer or dogs. In the west, railways to some extent are now available for traffic. A trade by sea has also been opened up between Europe and the rivers Obe and Yenisei. Extensive fairs are held at certain places. The principal towns are Tobolsk, Tomsk, Omsk, Krasnoïarsk, Irkutsk, and Yakutsk.

*People.*—The races and tribes scattered over the different parts of Siberia are so numerous that little more can be done here than to give the names of the more important. At least two-thirds of the whole population is Russian, and consists either of voluntary emigrants, who have found it their interest to settle in the country, or of exiles and their descendants. In regard to the exiles Siberia is merely a penal settlement, and hence that portion of the population which, as coming from Europe, ought to be the most civilized, is not likely to be the most exemplary. A more unsophisticated, and far more interesting, population is furnished by the indigenous tribes. Beginning at the Ural Mountains and proceeding eastward we find the Samoyedes in the north-west. Immediately south of these the Ostiaks occupy both sides of the Obe, up to the confluence of the Irtysh, the northern part of the steppe of Baraba, and the whole of the woody region eastwards to the banks of the Yenisei. They live by fishing and hunting, and though their physical structure is by no means robust they display both great dexterity

and courage in attacking the larger and fiercer animals, both of the land and water. Some of them have embraced Christianity, but the great majority continue addicted to Shamanism. In the south, among the Altai Mountains, the Kalmucks predominate, but have laid aside a number of the usual peculiarities of their race. They subsist chiefly on the produce of their horses, cattle, and sheep, and cultivate a little grain and tobacco. They have some skill in mechanical arts, particularly in the working of iron, and make their own gunpowder. Though not Buddhists they are generally addicted to other forms of superstition. Among the eastern slopes of the Altai are several Turkish tribes. The Buriats dwell chiefly on both sides of Lake Baikal, and eastwards as far as the Onon. They are of Mongol origin, and closely allied to the natives of the northern provinces of China both in language and customs. The Tunguzes or Toongooses are the most widely dispersed of all the native tribes, being found throughout many parts of Siberia from the Arctic shores to the frontiers of China. They are considered the best-formed of the native Siberians, are very expert horsemen, and live chiefly by hunting. The Yakuts live intermingled with the Tunguzes, and confine themselves almost entirely to the rearing of horses and cattle, and the preparation of dairy produce from them. They are of Tatar origin, and not a few of them are nominal converts to Christianity, though the majority, like the Tunguzes, still adhere to Shamanism. The Tchuktches occupy the north-eastern portion of Siberia, and their language proves them to have a common origin with the Esquimaux. Some of them spend their time in hunting and fishing, while others are nomadic in their habits.

*History.*—Siberia appears to have been partly conquered by Genghis-Khan and his successors, but did not become known to Europe till 1580, when a Cossack called Yermak Timofeyew, who had long robbed the vessels which navigated the Volga, finding himself hotly pressed by the Czar of Moscow, crossed over into Asia with his accomplices. Their number sufficed to form a small army, and their courage soon enabled them to acquire extensive settlements. These Yermak offered to the czar on the condition of obtaining pardon. The offer was accepted, and thus Russia for the first time obtained a footing in Asia. The territories thus conquered belonged to the Tatar prince Kutahum-Khan, and included his residence, which, called by the natives Isker, and by the Cossacks Sibir, has given name to the whole country. The conquests of Yermak were gradually extended, till the whole country west of the Ob was subjected to the czar. In 1604 the town of Tomsk was founded, and became a centre from which new expeditions were fitted out and new conquests made. Private adventurers, instigated chiefly by the hope of plunder, proceeded in all directions to the south, where, not without serious reverses, they succeeded in expelling the Kirghiz; and to the east, where they entered the basin of the Lena, subdued the Yakuts, and finally, after passing the Aldan Mountains, reached the Sea of Okhotsk. In the neighbourhood of Lake Baikal a formidable resistance was made by the Buriats, but their subjugation was finally completed in 1658. The town of Nerchinsk, which has since become so celebrated for its mines, was then founded, and, two years after, that of Irkutsk. A further extension of conquests to the south brought the adventurers into collision with the Chinese, and both governments taking part in the quarrel, a war, threatening the existence of one or other of the empires, became imminent. It was, however, prevented, partly by the intervention of the Jesuits resident at Peking, and a treaty in

1689 definitively fixed the boundaries of the two empires. A second treaty in 1727, confirming the former, regulated the commercial intercourse, and confined it to the two localities of Kiachta and Maïmachén. Never has so large a territory been acquired at so little expense. Russia, almost without any expenditure of her own means, and chiefly by the aid of a few Cossack adventurers, in little more than a century more than doubled her area. The greater part of it indeed is a frozen inhospitable region, which must always remain comparatively worthless; but vast tracts possess a climate and soil well adapted for agriculture, and seem destined to become the abodes of a dense population engaged in agriculture, mines, and fisheries. The Russian dominions were extended by the acquisition of the Amur territory and coast regions of Manchuria ceded by China in 1858 and 1860. Railways have for some time existed in the west, and a great railway across the entire country from west to east (broken at Lake Baikal) has been recently completed, thus directly connecting Europe with the Pacific coast. Its length is over 3700 miles. The population has recently been much increased by an influx of immigrants.

*SIBYL and SIBYLLINE BOOKS.* Sibyls were a kind of prophetic virgins, believed by the Greeks and Romans to be inspired by a god and able to unveil futurity. Ancient writers mention ten, among whom the Sibyl of Cumæ, in Campania, was the most celebrated. The Sibyl of Cumæ is said to have written in Greek verses the collection of prophecies famous under the name of Sibylline books, and containing the *fata urbis Romæ*, which, according to some, she herself, according to others an unknown old woman, offered to Tarquin for sale. When the king, on account of the high price asked, refused to buy them the old woman threw three of the books into the fire, and on a second refusal three more, after which the king, alarmed, paid for the three remaining the price originally asked for the whole, and committed them, as an oracle, to be consulted on important political occasions, to the keeping of two men (*duumviri sacrorum, interpretes, or sacerdotes sibyllæ*). The number at a later period was increased to ten, and by Sulla to fifteen. About that time (B.C. 83) the temple of Jupiter, where the Sibylline books were preserved, was burned down, with the capitol. On the capitol being rebuilt the senate sent delegates to the Italian and Greek cities, especially to Erythræ, to collect whatever Sibylline verses they could find; and after the rejection of those which were considered spurious about 1000 of them were retained, and preserved in the new temple of Jupiter Capitolinus. The senate at different times ordered all the pretended Sibylline books which could be found in private hands to be burned. Augustus did the same, and destroyed above 2000 such books, but caused the genuine Sibylline books to be preserved in two chests of gold under the pedestal of the Apollo Palatinus. Some years later Tiberius found it necessary to institute a fresh examination of the Sibylline oracles, and to strike out many considered to be spurious. In general the Sibylline books remained longer in authority with the Romans than the oracles with the Greeks. Though they were burned a second time in the reign of Nero they were again restored, and in the time of Aurelian (A.D. 270) some senators were in favour of consulting the Sibylline books respecting the event of the Marcomannic war. Yet they were then so corrupted that Christians could find in them predictions respecting the Meesiah. This collection was burned under Julian (A.D. 363), and a fourth collection was burned under Honorius (395), by Stilicho; in spite of which a fifth collection was believed to be genuine. When

Belisarius, in the middle of the sixth century, was besieged in Rome by the Goths two Sibylline verses were considered as predicting that the siege would last but five months, which, however, did not agree with the event. It may be easily imagined that the Sibylline books could have retained their authority through so many centuries only by the greatest vagueness, admitting of any interpretation, and never committing themselves. The still existing collection of Sibylline verses, most complete in the edition of Gallæus (Amsterdam, 1689), is of a later date, and is not considered genuine. These had their origin in the second century, when there were persons called *Sibyllists* in the Christian communities, who uttered poetic oracles, and whose outpourings were collected and also called Sibylline books.

SICARD, ROCH AMBROISE CUCURRON, successor of the Abbé l'Epée at the Parisian institution for the education of the deaf and dumb, was born September 20, 1742, at Fousseuret, near Toulouse, and entered into holy orders. He devoted himself to the instruction of persons born deaf and dumb, and became, in 1786, director of a school established for that purpose by the Archbishop of Bordeaux, whence, in 1789, he removed to Paris, and was chosen successor to the Abbé l'Epée, in whose system he made some important improvements. During the revolution he narrowly escaped with his life; and having under the Directory become one of the conductors of the *Annales religieuses*, it was only by concealing himself that he was enabled to avoid the consequences of a sentence of exile pronounced against himself and other journalists. On the overthrow of the Directory he resumed his duties at the school of instruction for the deaf and dumb. He died in May, 1822. Besides other works, he was the author of *Elémens de Grammaire générale appliquée à la Langue française* (two vols. 8vo); *Cours d'Instruction d'un Sourd-muet de Naisance* (8vo); and *Théorie des Signes pour l'Instruction des Sourds-muets* (two vols. 8vo).

SICILIAN VESPER, an appellation used to designate the massacre of the French in Sicily on the day succeeding Easter, 1282, the signal for the beginning of which was the first stroke of the vesper bell. Charles of Anjou had established himself, through the favour of the pope, in possession of Naples and Sicily. (See SICILIES, KINGDOM OF THE TWO.) The unfortunate Conradin had perished on the scaffold, October 29, 1268. But the haughty Charles ruled with an iron sceptre, and the oppressed people applied in vain for relief to the pope. Giovanni di Procida, a nobleman of Salerno, distinguished for his talents and accomplishments, determined to deliver Sicily from her sufferings. He had stood high in favour with the Emperor Frederick II. and King Manfred, and had been stripped of his estates by Charles on account of his attachment to the Suabian house. Meditating revenge, he went to Arragon, and invited King Peter, whose wife Constantia was a daughter of Manfred, to undertake the conquest of the Kingdom of Sicily. Peter was disposed to embrace his proposals, but he was destitute of money and men. Procida promised to make all necessary provision, and exerted himself accordingly. His efforts were successful, and on his return to Arragon Peter immediately began to make extensive preparations for the expedition, under pretence of an attack upon the Moors in Africa. Charles, though suspecting the truth, neglected to prepare any measures of resistance. On March 30, 1282, at the hour of vespers on Easter Monday, the inhabitants of Palermo flew to arms, and fell upon the French, who were all massacred. Women and children were not spared, and even Sicilian women

with child by Frenchmen were murdered. The other towns of Sicily at first remained quiet. Before the end of April Messina followed the example of Palermo, and the French were either murdered or driven from the city. Charles, who was at Orvieto with the pope, on receiving information of what had occurred appeared before Messina, and laid siege to it; but it was bravely defended, and before he could reduce it Peter of Arragon landed at Trapani, August 30, with 10,000 foot-soldiers and 800 men at arms, and entered Palermo, where he was hailed as king by the people. Charles, fearing the interruption of his connection with Calabria, thereupon raised the siege of Messina, and fled in haste across the straits, leaving behind him a great quantity of military stores. On October 2 Peter entered Messina, and was received with acclamations; whilst the pope excommunicated him and the Sicilians. In the following year Constantia appeared in Sicily with her sons, and was received as the rightful possessor of the island. The succession was settled on her second son, James. See Amari's *La Guerra del Vespro Siciliano* (Palermo, 1841).

SICILIES, THE KINGDOM OF THE TWO, a former Kingdom of Italy, consisting of Naples and Sicily. After the fall of the Western Roman Empire (A.D. 476) Lower Italy became subject to the Ostrogoths. About the middle of the sixth century Naples and Sicily fell under the power of the Greek emperors. Both countries were subject to one governor, the exarch of Ravenna, who conducted the administration by means of dukes. During the contest between the exarchs and Lombards there sprung up, in the ninth century, several independent duchies, such as Salerno, Capua, and Tarento. The most powerful was the Lombard duchy of Benevento. Naples, Amalfi, and Gaeta maintained themselves as republics. About the same time the Saracens invaded Calabria from Sicily. They conquered Bari, and contended with the Greeks for the possession of Lower Italy, until the Emperor Otho I. (967) subjected Benevento to the German Empire. Germans, Greeks, and Arabs now struggled for the possession of this beautiful country. This induced some warlike adventurers, Normans from France, in the eleventh century, to try their fortune here. They assisted the Greek duke Sergius against Prince Pandorf of Capua, and were rewarded with the tract of land on which they founded the town of Aversa. More Normans soon followed. In 1047 the twelve sons of Taureau de Hauteville, a count in Lower Normandy, came in with their followers. Among these brothers Robert Guiscard was the boldest and most artful. He contrived to gain over the peasants, and formed out of them his best soldiers. His policy led him to hold Apulia, which he had conquered, as a Papal fief (1053); and he promised likewise to hold as Papal fiefs such tracts as should afterwards be subdued by the Normans in Calabria and Sicily. He then (1060) took the title of Duke of Apulia and Calabria. His youngest brother, Count Roger, conquered Sicily in 1072, and, after the death of Count Robert and his sons, united in his own person the whole power of the house of Hauteville. His son and successor, Roger II., completed, after 1101, the conquest of all Lower Italy by subduing Capua, Amalfi, and Naples, at that time celebrated commercial republics. He then received, in 1130, from the anti-Pope Anacletus II., by whom he was solemnly infeoffed, the title of King of Apulia, Calabria, and Sicily. Uniting Sicily to his Italian dominions he now called his kingdom the Kingdom of the Two Sicilies. This union of Naples and Sicily continued 150 years. Each country preserved its existing laws. Into Naples, however, besides the ancient Lombard laws, the French feudal law was

also introduced. To the pope, as lord paramount of Naples, a tribute was paid of a palfrey and a bag of ducats. Roger II. was succeeded in 1154 by his son William I., the Bad, who two years later left his crown to William II., the Good (1156-89), during whose reign the kingdom rose to a high degree of prosperity and happiness. When William died in 1189 the race of Tancred became extinct. The German emperor, Henry VI., of the house of Hohenstaufen, now claimed the right of succession to the throne of Naples and Sicily, as belonging to his wife Constantia, the daughter of Roger II. The Sicilians, however, detested the German dominion, and elected Tancred, grandson of Roger, to be their king; and after his early death made choice of his son William III., a minor. Henry VI. then entered the kingdom a second time, with more success than during the lifetime of the brave Tancred, and by horrid cruelties maintained possession of it. His memory was held in abhorrence by the Sicilians; but they nevertheless allowed his son Frederick II., a child three years old, to succeed him in 1197. During the reign of this distinguished emperor Naples was made the capital. He was succeeded in 1250 by Emperor Conrad IV. The neighbourhood of the powerful imperial house was disagreeable to the popes, and they improved the minority of Conradin, the grandson of Frederick, to seize upon the kingdom. Manfred, a natural son of Frederick II., first regent for his nephew Conradin, then king on the pretended death of this young prince in 1268, became the special object of their hatred. Pope Urban IV. excommunicated him, and granted the Kingdom of the Two Sicilies to Charles of Anjou, brother of Louis IX. of France, who caused the legitimate heir, Conradin of Suabia (1268), to be beheaded. Sicily, however, freed herself in 1282 from the oppressions of the French (see SICILIAN VESPERS) by the aid of King Peter III. of Arragon, whom Conradin had made his heir, and whose wife was a daughter of Manfred. Sicily now remained separated from Naples for 160 years under the kings of Arragon, who withdrew the island from the feudal sway of the pope. In Naples the house of Anjou maintained itself, and Charles bound himself to pay an annual tribute to the pope of 8000 ounces of gold. His great-grandson Charles Robert, king of Naples, was made King of Hungary by the Hungarian Diet in 1307. After the death of King Robert in 1343 he was succeeded by his grand-daughter Joanna I., whose reign was marked by all sorts of domestic disorders and crimes. On her death in 1382 a bloody contest raged between Louis I., her adopted son, the head of the second house of Anjou, and Charles of Durazzo, her lawful heir. The latter ultimately triumphed, and united the Kingdoms of Hungary and Naples; but in the year 1386 he was assassinated in Hungary. His son Ladislaus maintained a successful struggle for the throne of Naples with Louis of Anjou. He took possession of Rome, and was on the point of uniting the whole of Italy into one kingdom when he died in 1414. He was succeeded by his sister Joanna II., whose reign of twenty-one years was as shameful and disastrous as that of Joanna I. Joanna adopted as her heir King Alfonso V. of Arragon and Sicily, who drove his rival, the French prince Louis III. of Anjou, out of Naples in 1458. Thus arose the jealousy between France and Spain, which, towards the end of the fifteenth century, wrapped the whole of Italy in flames. Alfonso V. was succeeded in Naples by his natural son Ferdinand I., whose grandson Ferdinand II. was attacked by Charles VIII. of France, the champion of the claims of the house of Anjou, and whose second son, King Frederick III., was dethroned by

his cousin Ferdinand V., king of Spain and Sicily, in conjunction with Louis XII. of France. The conquerors disagreed respecting the partition of Naples, and the cunning Ferdinand managed to establish himself in the sole possession of the whole, by artifice and force, in 1504. During this warfare of countries and crowns, which had been carried on for centuries almost without interruption, the constitution of the cities had been developed, and the kings of the house of Anjou began to summon delegates from them to the diet, which had been done previously in Sicily; but the feudal system continued, and the barons were constantly increasing their privileges. They even acquired the right of life and death over their vassals, in return for which the kings hoped to obtain their assistance in time of war. Thus the people were plunged into the greatest misery. At that period there were feudal estates which limited the power of the kings. But in the two centuries after the peace with France in 1505, during which the Kingdom of the Two Sicilies remained a part of the Spanish monarchy, the diets were no longer convened in Naples, and the viceroys consulted merely with a committee of the estates, in which the city of Naples represented the whole third estate. Thus the regal power increased, and with it the burden of taxes. The rebellion which took place in April, 1647, owing to the arbitrary mode of raising the taxes, might, under more prudent management, have led to independence. Still more did the prosperity of the country decline under the oppression of the nobility and the power of the clergy. No law limited the extension of the property of the church, and both in Naples and in Sicily two-thirds of the landed property gradually came into possession of the clergy. On the extinction of the Austro-Spanish male line, in 1700, Naples and Sicily fell into the hands of Philip V. of Spain, who governed arbitrarily without consulting the chambers. At the Peace of Utrecht, through the influence of the English, who were jealous of their commerce, Naples and Sicily were divided: the former fell to Archduke Charles of Austria, the latter to Duke Victor Amadeus of Savoy. King Philip V. of Spain reconquered Sicily in 1718, at the instigation of Alberoni, but was forced to cede it to Austria in 1720; and Savoy received Sardinia in return (see *SARDINIA*), by which means the Two Sicilies became a part of the Austrian dominions. In 1734 the Spanish Infante Don Carlos, son of Philip V., at the head of an army invaded Naples, defeated the imperial troops at Bitonto, May 25; conquered both the continental and the insular parts of the kingdom, and was crowned at Palermo, July 3, 1735, as Charles IV. This change was sanctioned by the Treaty of Vienna, November 18, 1738, and till 1860 the house of Bourbon maintained, except during the interval of a few years, possession of the Two Sicilies. In 1759, when Charles IV. ascended the Spanish throne under the name of Charles III., he conferred the Kingdom of the Two Sicilies on his third son Ferdinand, and decreed at the same time that it should never again be united to the Spanish monarchy.

The reign of Ferdinand IV., which thus commenced in 1759, in his minority, was long and eventful, extending through the stormy period of the French revolution and the subsequent European commotions, in which so many ancient dynasties were temporarily overthrown and their places supplied by mushroom potentates of Bonaparte's creation. For a detailed account of these events the reader is referred to the article *FERDINAND I.*, the title which Ferdinand assumed in 1816, when, after having been restored to all his dignities, he united his territories on both sides of the Straits of Messina into the Kingdom of

the Two Sicilies. His subsequent proceedings were, like those of most of the legitimate sovereigns restored in 1814, characterized by an unmistakable tendency to repress the progress of improvement and free thought, and rivet closely around his subjects the chains of absolute and unquestioned jurisdiction. The revolutionary rising, however, of 1820 compelled him to grant a constitution on the model of that then recently established in Spain, and this concession he ratified by oath. But after the sovereign congresses of Troppau and Laibach in 1821, when Austria promised him her assistance in quelling the Liberals, these obligations were shamefully disregarded, and by the help of Austrian arms Ferdinand was soon enabled to re-establish himself as an absolute monarch. He died in 1825, and was succeeded by his son, Francis I., who endeavoured to restore tranquillity by a partial amnesty for political offences, and also to extricate the financial department of government from the embarrassments in which it was involved. This course, however, was not pursued by his successor, Ferdinand II., the notorious King Bomba (1830-59), who rather followed in the footsteps of Ferdinand I. The least political disorder was severely punished; what remained of provincial liberties was abolished, and the people were kept in abject ignorance. But notwithstanding the political oppression under which the country laboured its condition as regarded material improvement was superior to that of the other states of Italy. Railways were laid down, an improved system of finance organized, the customs duties in many instances reduced, and advantageous treaties of commerce concluded with foreign countries. Towards the end of 1847 the revolutionary spirit, which for some time had been silently fermenting through the various states of Italy, began to exhibit unequivocal manifestations of its existence in the Kingdom of the Two Sicilies, and on the 12th January, 1848, the flames of insurrection burst out at Palermo with such violence and persistence as to render futile all attempts of the government to extinguish them. The royal troops were worsted, and were driven from all their posts except from the citadel of Messina, and a provisional government was established by the patriots. The king, alarmed, proclaimed on 29th January a new constitution, which guaranteed, among other fundamentals, the freedom of the press and universal suffrage. On 14th May, on the assembling of the new Neapolitan parliament, a dispute arose between the deputies and government as to the mode of taking the oath to the new constitution, which the former were determined not to swear to unconditionally. Another *émeute* now broke forth, and it was only after much bloodshed that the insurrection was suppressed. The king followed up his success, and within a few weeks Sicily was again in his power. An armistice was then concluded between the royal and patriotic parties, during which, protracted to March, 1849, vain endeavours were made by France and England to mediate between the king and his subjects. Hostilities now recommenced, and Ferdinand having assembled an overwhelming force was soon enabled to crush all resistance, Catania, Syracuse, and at last Palermo having successively yielded to his arms. The revenge taken by government was terrible. Not only was the constitution so recently solemnly sworn to set completely at naught but many of the political leaders were condemned to death, and such as escaped the gallows were cast into prison. To all representations of foreign powers on the subject of the shocking cruelties perpetrated upon political offenders under the name of justice the government continued obstinately deaf till at last Britain and France withdrew their ambassadors and refused to maintain diplomatic

relations any longer with a court whose proceedings were so repugnant to all the ordinary laws of humanity and justice. In 1859 Ferdinand died, and was succeeded by his son, Francis II., who showed himself a worthy successor of his father, and perseveringly followed out the same line of despotic policy which he had so doggedly adhered to. In 1860, however, an insurrection broke out in Sicily, and an expedition of volunteers from Piedmont and other Italian provinces under Garibaldi sailed from Genoa on the 5th of May to the assistance of the insurgents. After defeating the Neapolitan troops in several engagements, and all but driving them from the island, Garibaldi and his gallant band crossed the Straits of Messina. The desertion of several regiments of the royal army to the insurgents left Naples defenceless. On the 6th of September the king escaped to Gaëta, and two days after Garibaldi was enthusiastically received in the capital. A junction having been effected with the Piedmontese army entering Naples from the north, and the Neapolitan troops having been again defeated in more than one engagement, the people were asked to declare by a popular vote what form of government they wished for the future. By an overwhelming majority they declared for 'Italy one and undivided, and Victor Emmanuel as constitutional king.' Francis II. was soon compelled to surrender Gaëta and escape from his former dominions, and the Two Sicilies were added to the Kingdom of Italy. See ITALY.

SICILY (ancient, *Trinacria*), the largest island of the Mediterranean, belonging to Italy, and formerly a part of the Kingdom of Naples or of the Two Sicilies, and then named Sicilia-di-la-del-Faro. It is only separated from the south-western extremity of Italy by the narrow Strait of Messina, and extends from lat. 36° 38' to 38° 18' N.; lon. 12° 25' to 15° 35' E. It is nearly in the form of a triangle, whence its early name of Trinacria (*three-cornered*). The longest of the sides, represented by a straight line drawn from Cape Boeo to Cape Faro, is 180 miles; the next longest, from Cape Boeo to Cape Passaro, 171 miles; and the shortest, from Cape Passaro to Cape Faro, 113 miles. It is divided into the following seven provinces, each with a chief city of the same name:—

Provinces.	Area in sq. miles.	Population, 1901
Caltanissetta.....	1203	830,972
Catania.....	1917	711,923
Girgenti.....	1172	371,471
Messina.....	1246	548,898
Palermo.....	1948	785,016
Syracuse.....	1442	427,429
Trapani.....	948	353,557
Total.....	9930	3,529,286

*Physical Features.*—The coast, though presenting numerous small indentations, has few large bays. The interior is finely diversified. A range of mountains commencing in the north-eastern extremity of the island stretches across it in a w.s.w. direction, taking the name first of the Neptunian and then of the Madonian Mountains. This range, which lowers gradually in proceeding west, throws out numerous ramifications, the most important of which, breaking off from near its centre, proceeds somewhat circuitously south-east towards Syracuse. The whole range bears a strong resemblance to the branch of the Apennines which stretches to the southern extremity of Italy, and strongly countenances the opinion generally entertained that it was originally continuous with it, and that Sicily consequently must at one time have been not an island but a part of the European continent. The most remarkable natural feature of Sicily, and one of the greatest wonders of the world, is Mount Etna, which attains a height of 10,874 feet

(See *Ætna*.) Compared with this all the other summits of the island are insignificant, the loftiest of them, Calatabellota, Monte Cuocio, Monte Scuderi, and Dinnamare over Messina being all between 3000 and 4000 feet. The great majority of the mountains have a far less average height. Their sides are generally covered with magnificent forests wherever from their loftiness or ruggedness they cannot be brought under regular cultivation. Between the mountains deep and romantic valleys often intervene, and occasionally the ruggedness of the country altogether disappears, and large, beautiful, and fertile plains are seen stretching out almost as far as the eye can reach. The most important of these plains are those of Catania and Melazzo on the north-east, Syracuse on the south-east, and Terranova on the south. The rivers and streams are very numerous, and not a few of them of classical celebrity, but they are individually insignificant, and in summer are often almost without water. The most deserving of notice are the Giarretta or Simetis on the east coast, the Salso, Platani, Calatabellota or Isbura, and Belice on the south and south-west, and the Termini, Fiume Grande, and Pollina on the north. There are no lakes worthy of the name; the largest is Lentini, not far from the east coast.

*Climate.*—The climate is excellent, and except in some spots where the air becomes tainted by the effluvia of morasses and stagnant pools very healthy. The thermometer in the hottest days rises to 90° or 92°, and even in the depth of winter very seldom falls below 36°; the medium temperature is 62° 5'. The sky in summer is for the most part beautifully clear and serene, but after the autumnal equinox dews and fogs increase, and rain falls in frequent and heavy showers. The most annoying wind is the south-east or sirocco, which, blowing from the deserts of Africa, is almost intolerable from its stifling heat. Much rain falls in winter, usually commencing in November, and continuing to fall at intervals, often in very heavy torrents, with vivid lightning, and occasional snow-storms, till March, while not unfrequently, particularly in the interior, long droughts prevail from April to November, to the serious injury of the harvest and vintage. Another evil from which Sicily suffers is the frequency of desolating earthquakes. These have repeatedly spread fearful devastation over whole tracts of country, and even when unaccompanied with actual damage keep the minds of men in a state of anxiety and alarm.

*Geology.*—Etna itself, and the large circular space of which it forms the centre, extending west to Bronte and east to the coast over the whole tract that lies between Catania and Taormina, is covered completely with volcanic products. Granite, with gneiss and mica-schist, has its only large development in the north-east. The Jura-limestone occupies only two small patches; but the series of rocks immediately above the limestone and belonging to the cretaceous system are so largely developed as to cover at least a half of the whole surface of the island. The rocks of the tertiary formation occur chiefly in the south-east and the west. The minerals of Sicily are more numerous than valuable. They include argentiferous lead, quicksilver, iron, copper, and antimony in quantities so limited that few of them are worked; lignite, bitumen, petroleum, and naphtha; asbestos, gypsum, emery, alum, rock-salt, nitre, sulphur, and a great variety of marbles, agates, chalcedonies, and jaspers. The most important of all these is sulphur, which has been worked in mines for more than three centuries, and is extensively exported.

*Vegetation, &c.*—Both the climate and rich soil of the island procure for it both a very large amount and great variety of vegetable products. The hilly

regions, presenting alternately bold crags and undulating slopes, are generally clothed with forests of fine timber, among which the prevailing trees are oak, ash, pine, elm, and chestnuts; or covered with pastures, on which numerous flocks and herds are reared. In the lower grounds cultivation is general, and the crops are often remarkable for their luxuriance, though the mode of culture is for the most part unskilful and careless in the extreme. The most important crops are wheat, maize, barley, and lentils, or other pulse. Next to grain the most important objects of culture are the vine and the olive, the orange and the lemon. The produce of the vine is partly dried into raisins, but is much more frequently converted into wines of various kinds, and generally of rich flavour. Other vegetable products deserving of notice are the mulberry, extensively used in rearing silk-worms; saffron and sumach; cotton, which has its chief locality near Mazzara; manna obtained by incisions in the bark of a species of ash (*Fraxinus ornus*), various species of fruit, more especially the Indian fig or prickly-pear (*Cactus opuntia*), on which when in season great numbers of the lower orders subsist, the almond, common fig, date, liquorice-plant, and sugar-cane. To these might be added a great number of trees and plants valuable for fruit, fibre, medicinal properties, or the essences extracted from them. The domestic animals of Sicily, with the exception of goats, of which there is a good breed, and of mules, to the proper rearing of which a great degree of attention is paid, are of an inferior description. The horses, though descended from those of Barbary, have lost traces of the good qualities for which the parent race are distinguished, and the sheep, with exception of a few improved merinoes, rank low in respect both of carcass and wool. Oxen, especially those used for draught, are strong, and tolerably well formed, but the cows are ill adapted for the dairy. Swine are numerous, and where tracts of forest extend thrive vigorously. In general, however, the breed is wretched in the extreme.

*Manufactures, Trade, &c.*—The manufactures are of very limited extent, and when not entirely domestic are confined to a few of the larger towns. They include the ordinary silk, woollen, linen, and cotton tissues, for the most part of a coarser description; oil-cloths, leather, cordage, glass, earthenware, &c. Trade suffers much from want of inland communication, but the vast extent of sea-coast, and the many valuable products indigenous to the island, should make it much greater than it is at present. The only occupation for which the Sicilians seem to show any particular predilection is that of fishing, for which they possess numerous advantages, the fisheries along the coast being the finest in the Mediterranean. By far the most productive is that of the tunny, for the capture of which at the proper season whole fleets of boats are fitted out. The mullet and anchovy fisheries are also of great value, and numerous varieties of Mollusca and Crustacea, affording delicate food, are taken throughout the year. The most important articles of export are oranges and lemons, wines, essences, sulphur, olive-oil, sumach, silk, liquorice, and cream-of-tartar; of imports, colonial produce, cotton and woollen yarn, silk, linen, cotton, and woollen goods, hides, hardware, &c.

*Religion, Education, &c.*—The Roman Catholic is the established religion, and the great body of the people nominally belong to it, though a considerable number of Greeks, who profess the worship of their own church, live in different parts of the island, and more especially in the vicinity of Palermo. The greatest bigotry, accompanied with the grossest immorality, is very prevalent among the higher, and has also spread widely among the lower orders.

Education is very much neglected. As late as 1864 upwards of nine-tenths of the population were wholly uneducated. National schools are now, however, everywhere established, and the towns possess commercial and grammar schools. Palermo, Catania, and Messina can even boast of universities, though, that of Palermo excepted, they are very insignificant.

*History.*—According to early tradition the first inhabitants of Sicily were Cyclopes and Lestrygonians, a kind of fabulous beings, who long furnished the poets with ample materials, of which, among others, Virgil has largely availed himself. Sicanians from Iberia afterwards gained such a footing in the island, as to change its name from Trinacria, which it had hitherto borne, to that of Sicania. The Siculi, driven from Italy, crossed the straits, and having vanquished the Sicanians, gave the island the name which it still bears. After a considerable interval the Greeks began to plant colonies on the coast, and founded a number of towns, of which Syracuse, Agrigento, and Messina became the most celebrated. They were not, however, allowed to remain in undisturbed possession. The island was conquered first by the Carthaginians, and next by the Romans; and on the decline of their empire it was overrun by the Goths, who retained possession till Belisarius expelled them. In the beginning of the ninth century the Saracens became masters, and continued so till their expulsion by the Normans, who remained long enough in possession to establish the feudal system in all its rigour. For a continuation of the history of Sicily see SICILIES (THE KINGDOM OF THE TWO). See E. A. Freeman's History of Sicily from the Earliest Times (4 vols., Oxford, 1891-94; the last volume edited by his son-in-law, A. J. Evans).

SICKINGEN, FRANCIS VON, a German knight of the palatinate of the Rhine, imperial counsellor and general, one of the noblest characters of the disturbed times in which he lived, was born in 1481, at the castle of Ebernburg, in the Duchy of Baden. From early youth he devoted himself to the military life. The protection of the oppressed was his chief occupation. He assisted many a creditor in procuring what was due him from a powerful debtor. He was the enemy of tyranny, and endeavoured on every occasion to repress the despotism of princes and the arrogance of the priests. Without being a scholar he loved science, and protected men of learning (for instance, Reuchlin, whom he defended against the monks of Cologne); and in his castle of Ebernburg many persecuted scholars found a safe asylum. He was a friend of the Reformation, and contributed greatly to extend it in the countries which bordered on the Rhine. At last he engaged in a quarrel with Treves, the palatinate, and Heesse, which drew upon him the ban of the empire. He died in 1523, soon after the surrender of Neustall, one of his castles, having previously received a severe injury from a fall during a Sally.

SICYON (now *Vasilica*, a village with about fifty families), one of the oldest, most celebrated, and handsomest cities of ancient Greece, lying not far from the Gulf of Corinth, on which it had a port. The Sicyonians enjoyed so much consideration, that, with the Spartans, they acted as umpires and mediators. They were not less distinguished for their superiority in the arts of peace than the Spartans for their military fame. Sicyon, although powerful by sea, was seldom engaged in wars; but was celebrated for its schools of sculpture and painting. It gave its name to a school of painting which numbered among its disciples Pamphilus and Apelles, both natives of Sicyon. The city, with its environs, having the Gulf of Corinth for its northern boundary with Achæa, Phlius, and Corinth for its western, southern,

and eastern boundaries respectively, formed a small state (Sicyonia) at a very early period; and the names of several princes, who are said to have reigned there, are given. At the time of the return of the Heraclidae it formed a part of the Kingdom of Argos. It afterwards became a democracy, and the supreme power was several times usurped by individuals. It maintained its independence subsequently to the period of the Persian war, but suffered much from the civil contests among the Greeks, in which it was sometimes in favour of, and sometimes in opposition to, Athens. Sicyon was induced, by the influence of Aratus, who was a native of the town, to join the Achæan league, in which it acted an important part, and of which it finally shared the fate, and fell under the dominion of Rome.

SIDDONS, MRS., daughter of Roger Kemble, the manager of an itinerant company of players, was born at Brecon, in South Wales, in 1755. She commenced her theatrical career when quite a child. In her fifteenth year a mutual affection sprang up between her and Mr. Siddons, then a young man acting in her father's company; but her parents, considering her too young to form a connection with him, placed her as a kind of companion with a lady in Warwickshire. In her eighteenth year, however, she was married to Mr. Siddons, with their consent; and the newly-married pair acted together at Cheltenham. The renowned Mrs. Siddons here acquired induced the manager of Drury Lane to offer her an engagement, which she accepted. Her appearance there failed to make any strong impression, though she was favourably received, and having offended Garrick, by inadvertently in an important scene causing him to act with his back to the audience, he never forgave her, and she was not re-engaged. After this she acted successively at Birmingham, Manchester, York, and Bath, increasing her reputation to such a degree that she was again engaged at Drury Lane. The re-appearance of Mrs. Siddons in London took place on the 10th of October, 1782, in the character of Isabella in the Fatal Marriage. Her success was complete. The public were astonished by her powers, and she was universally acknowledged to be the first tragic actress of the English stage. She subsequently visited Dublin and Edinburgh with equal applause. In 1784 some calumnies circulated against her with respect to her conduct towards certain of her fellow-performers occasioned her to meet with an unkind reception from a London audience, and affected her so much that she resolved to retire from the stage; but the calumnies were speedily refuted and her resolution was given up. For thirty years she continued to astonish and enchant the lovers of the drama, and having acquired an ample fortune, she took her leave of the stage in 1812, before an audience which melted into tears on the occasion. She, however, performed in 1816 for the benefit of her brother Mr. Charles Kemble, and a few nights in Edinburgh to assist her daughter-in-law. Her greatest characters are well known to have been Catharine in Henry VIII., and Lady Macbeth, in which she manifested a dignity and sensibility rarely equalled. She died June 8th, 1831. Mrs. Siddons, unequalled as a tragic actress, and the ornament of the social circle in which she moved, was also of an unblemished reputation, and enjoyed the respect of all who knew her. See Campbell's Life of Mrs. Siddons.

SIDEREAL SYSTEM, the system of stars. The sun with its system is considered a member of the sidereal system in the same sense as the earth with its moon, and Saturn with its satellites, are considered members of the solar system.

The constitution of the sidereal system is not

known, and none of the theories which have been put forward can be regarded as more than tentative efforts to account for the few known facts. The whole subject is beset with difficulties which would appear to be insurmountable if the history of all science were not a history of difficulties surmounted. In connection with this subject it is felt, first, that the time during which accurate star observations have been made has been too short to allow of our coming to reliable conclusions as to the proper motions of the stars; second, that the most powerful telescopes yet made fall very far short of the powers necessary; and, third, our longest base-line (the distance between two opposite points of the earth's orbit) is too short to admit of our obtaining even approximate estimates of the distances of the stars. Some have considered that the stars are near in proportion to their brightness; but while it is probable that the bright stars, as a rule, are nearest to us, it is certain that a vast number of telescopic stars owe their dimness to smallness and not to distance. Halley noticed that Sirius, Aldebaran, and Arcturus do not appear in the positions assigned to them by Ptolemy; and thus attention was drawn to the fact that the stars, including our sun, are not fixed. Different astronomers have attempted to get a notion of the direction of the proper motion of the sun. In 1783 and again in 1805 Sir William Herschel, by the examination of the proper motions of a small number of stars, concluded that the sun is moving towards a point in the constellation Hercules. Many later observers have proved Herschel's result to be substantially accurate, but the objective of the sun's journey is now placed in the borderland of Hercules and Lyra. Sir W. Herschel adopted a system of star gauging in order to form an idea of the figure of the sidereal system. He imagined that on the whole the stars are evenly scattered over the system, and that, in looking through them with a telescope, stars will be most numerous where the line of vision has to penetrate the greatest depth of star-occupied space. By this method he arrived at a general view of the plan of the sidereal system, but later in life he abandoned the assumption of uniform distribution. Many others since Herschel's time have tried to formulate a general scheme of the starry universe. Argelander thought the central sun of the universe was in the constellation Perseus, and Mädler made Alcyone, situated in a region of slow movements, the supreme seat of universal gravitation. In more recent times R. A. Proctor has shed light upon this difficult question. In particular, he showed that several star groups which at first seem disconnected are in reality moving together. Sir William Huggins's researches by means of spectroscopy on the motions of stars in the line of sight are of the utmost value in this connection.

**SIDEREAL TIME**, time measured by the apparent motion of the stars. A *sidereal day* is the time from the passage of a star across the meridian till its next passage. If the stars are supposed to be absolutely fixed and at an infinite distance, a sidereal day is exactly the period of the revolution of the earth on its axis; the effects of the motions of the stars and the motion of the earth in its orbit are insensible. A sidereal day is the most constant unit of time which we possess; but it appears that it is increasing in duration very slowly. The length of a sidereal day is 23 hours 56 minutes 4.092 seconds. A *sidereal year* is the exact period of the revolution of the earth round the sun. Suppose the centre of the sun, the centre of the earth, and a fixed star in one straight line, after the lapse of a sidereal year they are again in the same straight line. There are 366.2563612 sidereal days in a sidereal year.

**SIDLAW HILLS**, a low mountain range in Scotland, which, commencing with the Hill of Kinnoul, on the left bank of the Tay near Perth, stretches E.N.E. into Forfarshire, in which stand the loftiest summits, namely, Craigowl (1493 feet) and Auchterhouse Hill (1399 feet). One of the lower peaks is the Dunsinane Hill of Shakspeare's Macbeth. The average height of the range is below 1000 feet. The eastern slopes are covered with corn-fields and rich pastures, on the west is the valley of Strathmore. Geologically, the range consists of igneous rocks of lower Old Red Sandstone age, with some intrusive masses of basalt.

**SIDMOUTH**, a market-town and watering-place of England, on the south coast of Devonshire, 15 miles E.S.E. of Exeter, situated in a finely-sheltered vale, at the mouth of the Sid. It has hotels, boarding-houses, and other appendages of a fashionable seaside resort. Queen Victoria lived here with her parents in the first year of her life, and her father, the Duke of Kent, died here in 1820. A stained glass window in memory of him was presented to the ancient Perpendicular church (rebuilt 1860) by the late queen in 1866. Besides other churches there is a convent, a market-house, a mechanics' hall, a manor hall, a cottage hospital, &c. Pop. (1891), 3758; (1901), 4201.

**SIDNEY, ALGERNON**, second son of the Earl of Leicester by the daughter of the Earl of Northumberland, was born in 1622. He was educated under the inspection of his father, whom he accompanied in his embassies to Denmark and France. He was also early trained to a military life, and served with some distinction along with his brother, Viscount Lisle, during the Irish rebellion. In 1643 both brothers returned to England and joined the parliamentary forces. In 1645 Algernon was promoted by Fairfax to the colonelcy of a regiment of horse, and in 1646 he was made lieutenant-general of the horse in Ireland and governor of Dublin. In the following year he returned to England, and after receiving the thanks of Parliament for his services was made governor of Dover. In 1649 he acted as one of the judges at the trial of Charles I., though he was neither present when sentence was pronounced, nor signed the warrant for the execution. It appears, however, that he vindicated that measure, it being reported that he declared it to be 'the justest and bravest action that ever was done in England or anywhere else.' During the government both of the Protector and his son Richard he lived in retirement at Penshurst, where he is supposed to have composed his celebrated Discourses on Government. When the return of the Long Parliament, in May, 1659, gave expectations of the establishment of a republic he assumed a public character, and was nominated one of the council of state. He was soon after appointed a commissioner to mediate a peace between Denmark and Sweden, and while engaged in this embassy the Restoration took place. Conscious of the offence he had given the royal party, he refused to return, and remained an exile for seventeen years. At length, in 1677, the influence of his friends procured his pardon and permission to return to England. His republican spirit, however, was still untamed, and he entered upon various schemes for the overthrow of the monarchy and the establishment of a republic. It appears also, from the papers of Barillon, the French ambassador, that he solicited aid for the carrying out of his schemes from France, and his name occurs among those who received pecuniary assistance from that court. In the Ryehouse Plot he is named as one of a council of six who were to organize an insurrection in conjunction with the Scottish malcontents. It was, however, for

his supposed share in the subordinate conspiracy for assassinating the king that he was arrested, with Lord William Russel (see *RUSSEL, WILLIAM*) and others. After the sacrifice of the latter he was tried, as the next most obnoxious person, for high treason, before Chief-justice Jeffreys, November 21, 1683. There was no direct evidence against him except that of the vile Lord Howard of Esrick, while the law for high treason required two witnesses. To supply this deficiency papers alleged to be his were produced, and were received as evidence against him. On this imperfect evidence, and in spite of his spirited defence, he was declared guilty, and condemned to death. Sidney was executed on Tower Hill, December 7, 1678, and suffered with all the firmness and constancy belonging to his character. 'The manifest iniquity of his sentence,' says Hallam, 'as well as the high courage he displayed throughout the last scenes of his life, have inspired a sort of enthusiasm for his name which neither what we know of his story, nor the opinion of his contemporaries, seems altogether to warrant.' Burnet speaks of him as of extraordinary courage, steady even to obstinacy, impatient of contradiction, and a decided enemy to monarchy and church government. His *Discourses on Government* were first printed in 1698, and reprinted in 1740 and 1751 in folio, and in 1772 in quarto, at the expense of Thomas Hollis, Esquire, with the trial letters prefixed. They contain much historical information, and are composed with clearness, acuteness, and force.

SIDNEY, SIR PHILIP, an ingenious writer and accomplished statesman in the reign of Queen Elizabeth, was the son of Sir Henry Sidney of Penshurst, in Kent, where he was born November 29, 1554. After studying at Christchurch, Oxford, and Trinity College, Cambridge, he set off on his travels at the age of eighteen, visited France, Hungary, and Italy, and, returning through Germany and Flanders, arrived in England in 1575. He became a favourite with the queen, who in 1576 sent him on an embassy to Germany. Having had a quarrel with the Earl of Oxford, in consequence of a dispute at a tournament, her majesty interposed her authority to prevent a duel from taking place. Sidney, displeased at the issue of the affair, retired to Wilton in Wiltshire, 1580, and amused himself with the composition of his celebrated pastoral romance *Arcadia*. In 1583 he married Frances, daughter of Sir Francis Walsingham, having previously met with a severe disappointment in the marriage of Lady Penelope Devereux, the 'Stella' of his poems, and the 'Philoclea' of the *Arcadia*, to whom he was deeply attached. The prince-palatine being invested with the order of the Garter in 1583, Sidney was appointed his proxy, when he received the honour of knighthood. In 1585 he projected, in concert with Sir Francis Drake, an expedition against the Spaniards in America, and he had gone to Plymouth to embark on the undertaking, when an express mandate from the queen recalled him to court. Her influence also was exerted to prevent him from being elected King of Poland, 'refusing,' as Camden says, 'to further his advancement out of fear that she should lose the jewel of her times.' He was subsequently appointed governor of Flushing, and general of the cavalry under his uncle Dudley, earl of Leicester, who commanded the forces sent to assist the Dutch against the Spaniards. September 22, 1586, being at the head of a detachment of the English troops, he fell in with a convoy of the enemy marching towards Zutphen. An engagement took place, in which his party gained the victory, dearly purchased with the life of their commander, who received a shot in his thigh, which shattered the bone. An incident that

occurred as he was being borne off the field illustrates his character. It is thus recorded by Lord Brooke, his biographer:—'In which sad progress, passing along by the rest of the army where his uncle the general was, and being thirsty with excess of bleeding, he called for some drink, which was presently brought him; but as he was putting the bottle to his mouth he saw a poor soldier carried along, who had eaten his last at the same feast, ghastly casting up his eyes at the bottle. Which Sir Philip perceiving, took it from his head before he drank, and delivered it to the poor man with these words: 'Thy necessity is greater than mine.' He was carried to Arnheim, where he expired, October 17. His body was carried to England, and after lying several days in state was buried in Old St. Paul's Cathedral. So universally was he esteemed that a general mourning for him was observed throughout the whole country. He was panegyrized by his contemporaries, and the universities issued three volumes of elegies on his death. His works, besides the *Arcadia*, consist of the *Defence of Poesy*; *Astrophel and Stella*; a collection entitled *Songs and Sonnets*; and other poetical pieces. The *Defence* was republished in 1752 (12mo) and in 1831 (Boston), and a complete edition of his works appeared in three vols. 8vo (London, 1725). His *Miscellaneous Works*, with a Life by W. Gray (one vol. 8vo), appeared at Oxford (1829). The work by which Sir Philip Sidney is principally known is his *Arcadia*, which is one of the earliest specimens of the grave or heroic romance. It is a mixture of prose and verse, the latter exhibiting various attempts to naturalize the measures of Roman poetry. See the Life of Sidney by Sir Fulk Groville, and the biography by H. R. Fox Bourne (1862; new edition, 1891, in series of *Heroes of the Nations*).

SIDNEY SUSSEX COLLEGE, Cambridge, was founded in 1594 by Lady Frances Sidney, countess-dowager of Sussex, aunt to Sir Philip Sidney. There are ten fellowships, twenty-four scholarships, and a number of exhibitions. The scholarships vary in value from £30 to £60 a year. The college was erected on the site of an ancient Franciscan convent. It consists of two courts much defaced by modern alterations. Oliver Cromwell and Thomas Fuller were members of this college. There are eight benefices in the patronage of the college.

SIDON, or ZIDON (Hebrew, 'Fishing' or 'Fish-town'), an ancient and wealthy city of Phœnicia, situated on the eastern coast of the Mediterranean Sea, on a plain scarcely 2 miles wide, between Lebanon and the sea, about 20 miles north of Tyre. Its great antiquity may be inferred from the ethnological assertion that Zidon was the first-born of Canaan; and that it was more ancient than Tyre appears probable from the circumstance that Tyre is not mentioned in the Pentateuch at all, while Zidon is referred to in terms that give it the pre-eminence among Phœnician cities; and, moreover, the term Sidonians is sometimes used, both by scriptural and classical writers, as synonymous with Phœnicians. Sidon was built on the northern slope of a small promontory that runs out into the water a few hundred yards towards the south-west, and formed what Strabo calls 'a fine naturally-formed harbour.' Many massive substructures are yet to be seen. The fields around are very fertile and beautiful, watered, as probably in early times, with numerous channels out from the 'streams of Lebanon.' The artistic products of Sidon were famous at an early period. Allusion is made in the Homeric poems to 'the richly embroidered robes' of Sidonian manufacture, and to 'the most beautiful cup on the whole earth,' the work of the 'ingenious Sidonians.' Sidon was also famous for its manufactures of glass, linen,

purple dye, and perfumes. In commercial enterprise it occupied a distinguished position, and its ships were renowned all over the world. Sidon had its own king, like the other Phœnician cities, and although it was one of the places assigned by Joshua to the Israelites, it never really belonged to them. At one time Sidon was subject to Tyre, but it took the opportunity afforded by the inroad of the Assyrian Shalmanezzer to revolt. In the Persian period it was great and populous, but rebelled against Artaxerxes Ochus, and though at first successful, was finally so sore pressed that in their desperation 40,000 persons, shutting themselves up with their wives and children, set fire to their dwellings, and perished. The city, however, was speedily rebuilt, and again flourished. Their detestation of the Persians led the Sidonians to open their gates to Alexander the Great after the battle of Issus in 333 B.C., and their fleet helped them against Tyre. Sidon then passed through several fluctuations of fortune, and was again great and powerful in Roman times. During the Crusades it was taken by Baldwin in 1111, and retaken by Saladin in 1187. In 1291 it finally fell into the hands of the Moslem. In the seventeenth and eighteenth centuries it was a seat of French commerce. Sidon, now called Saïda, has still a population of about 10,000, but is a place of little importance. A number of sarcophagi, valuable for their artistic features, have recently been discovered here.

**SIEBENBÜRGEN.** See TRANSYLVANIA.

**SIEBENGEBIRGE** (German 'Seven Mountains'), a small mountain range on the right bank of the Rhine, near the town of Königswinter, not far from Bonn, consisting of basalt, granite, porphyry, and sandstone. Seven mountains tower above the rest, of which the Drachenfels, close to the Rhine, and presenting a splendid view from the river, is the most beautiful, and the Oelberg, 1520 feet high, the highest. On all of them are ruins of ancient castles.

**SIEGE**, the surrounding or investment of a fortified place by an army with a view to its capture. The taking of a fortified place may be attempted (1) by surprise, in case the defenders should be off their guard, or treachery should enable the assailants to enter the fortress by means of secret or unguarded passages; (2) by a sudden onset, usually connected with an assault and scaling of the walls (*escalade*), if the place should not be strongly garrisoned or not in a proper state of defence, or if the assailants have no time to lose, or are possessed of strength and means sufficient for carrying their point at once; (3) by blockade out of gun-shot (see **BLOCKADE**); (4) by a siege, properly so called. In a regular siege the fortress is gradually approached by passages and advanced works, which cover the besiegers from the enemy's fire. The fortress is first blockaded, so as to cut off all intercourse from without, the besieging force encamping just beyond reach of the enemies' guns; it is then important to examine more closely the nature of the fortifications, and, if possible, the weakest parts of the place, in order to mark out a proper plan of attack; after this the cannon, together with the necessary ammunition and implements for the siege-works, are brought forward; and the other requisites (fascines, gabions, &c.) are prepared. The engineer who directs the operations must accurately calculate his time, the resistance to be expected, as well as the means at his disposal, and form his plan of attack accordingly. If any detached works are situated before the fortress, their capture becomes necessary to admit the opening of the trenches or sunken ways for the attack of the main fortress. In order to get over the intervening ground with the least possible risk of being cut up

by the enemies' fire, a series of trenches is formed in the direction of the fortress; but that these may not be enfiladed by the fire of the place attacked, they must proceed in a zigzag form. For the protection of the workers against a sortie, trenches called *parallels*, because they run in a direction parallel or nearly so to the front or portion of the fortress assailed, are dug at intervals, and troops located in them. Operations commence with the construction of the first parallel after the line of it has been duly traced. The distance from the covered way at which ground should be broken for this trench must vary with the character of the enemies' fire, increasing as that is more deadly. From 600 to 1000 yards has been most usual, but in some recent sieges ground has been broken at a much greater distance than this. This parallel usually extends either way some distance beyond the fronts attacked, and terminates at each extremity in a redoubt if no natural obstacle, such as a river or morass, renders such unnecessary. For the method of digging the trenches see the article **SAP**. When the first parallel is finished, enfilading batteries are erected in front of it, and then the zigzags are proceeded with until they approach near enough to render a second parallel necessary. At intervals in the progress of the zigzags short spurs of trench are cut, so as to allow the admission of a small body of troops for the protection of the workers. The besieged, by sallies and counter operations of every kind, strive to drive off the assailants, and to destroy their work; while the besiegers make efforts to establish themselves more and more securely, to raise batteries, and then, by means of trenches and advanced parallels to approach the fortress, while the artillery is kept constantly playing from the batteries on the garrison as well as the works and guns of the besieged. From the last parallel, which approaches very near the ditch or moat of the fortress, the besiegers prepare to cross this, and endeavour to make breaches. Here likewise mining operations (see **MINE**) are carried on whenever they are found advisable, the mines of the besiegers being most probably met by the counter-mines of the besieged. The moat is crossed by the double sap, or covered passages of a similar kind, and should it be filled with water, on rafts, bridges, &c. When at last the breaches are practicable, the garrison and their artillery impaired, then follows the storming or scaling of the walls. The besieging force should generally be four times the strength of the garrison.

**SIEGEN**, a town of Prussia, province of Westphalia, government of Arnsberg, on the Sieg. It has two Protestant and a Roman Catholic church, a real-gymnasium, school of mining, &c.; manufactures of cotton and linen goods, leather, soap, paper, articles in iron and steel, &c. In the vicinity are iron-mines and smelting furnaces. Pop. (1900), 22,111.

**SIEMENS**, **SIR CHARLES WILLIAM**, the celebrated inventor, was born at Leuthe, Hanover, 4th April, 1823. He was educated at the gymnasium at Lübeck, the polytechnic school at Magdeburg, and at the University of Göttingen. At the age of nineteen he became a pupil in the engine works of Count Stolberg. A year later he visited England for the purpose of introducing a method of electro-gilding, the joint invention of his brother Werner and himself. In the same year the brothers invented a differential governor for steam-engines, and in 1844, C. W. Siemens again went to England to patent this invention. From that time he settled in England, of which he became a naturalized subject in 1859. Among the many other inventions with which he, in combination with his brothers, must be credited, are the regenerating gas furnace for metallurgical pur-

poses, the process of making steel and iron direct from the ore (which has revolutionized the steel and iron trades), improvements in the manufacture and laying of telegraph lines, the world-famous electric-lighting machines, &c. The honours he received for his inventions and discoveries were numerous: we can only mention the degree of D.C.L. conferred by Oxford University in 1869, and the honour of knighthood bestowed in April, 1883. He died on the 19th Nov., 1883.

SIENA, or SIENNA (anciently, *Sena Julia*), a city of Central Italy, on the spurs of two hills which rise from the borders of a barren and dreary tract on the southern frontiers of Tuscany, 29 miles south of Florence. Its lofty site, and the fine avenue of trees by which it is approached, give it at a distance a very pleasing appearance; but the streets are irregular and narrow, many of them being mere lanes, often so steep as to be almost inaccessible by carriages. It is nearly of a triangular shape, is surrounded by walls with gates, of which several are well deserving of notice, and is defended by a strong citadel situated at its north-western side. The most remarkable buildings and establishments are a Gothic cathedral, with a curious façade inlaid with black, red, and white marble, and covered over with sculptures and decorations; several other churches, many of them imposing structures, and almost all rich in works of art; the Palazzo Pubblico, now occupied as public offices, courts of law, &c., and finely situated in the Piazza di Vittorio Emanuele, a large open space sloped like an ancient theatre for public games; palaces in great number, and in almost every variety of simple and compound Gothic; the university, of very early date, once celebrated, but now greatly decayed; the public library, containing 50,000 volumes and above 5000 MSS., many of them of great rarity and value; the Hospital of Santa Maria della Scala, one of the most ancient in Europe, and containing 300 beds; the lunatic asylum; and various other benevolent institutions. The manufactures are not of much importance; the trade is chiefly in corn and fine marble. Siena is the see of an archbishop, the seat of civil and criminal courts, and possesses academies and societies for literature, science, and art. Its foundation is of very ancient date, as attested by its Etruscan walls, of which portions are still visible; but its chief interest is derived from the important position which it occupied among the early Italian republics. It is said to have then had 150,000 inhabitants and repeatedly sent large armies from its gates. It has given birth to a great number of remarkable individuals, and furnished no fewer than seven popes. Pop. (1901), 28,678.

SIERRA (Spanish, 'a saw'), a term applied in Spain and Spanish-peopled countries to a ridge of mountains.

SIERRA LEONE, a British colonial territory in Western Africa, consisting of a colony proper and a much more extensive protectorate. The colony consists of the peninsula of Sierra Leone (containing the capital, Freetown), about 25 miles long and 12 miles broad, of Sherbro Island and a few islets, and of all the coast strip between French Guinea and Liberia; total area, about 3000 square miles. The protectorate extends inland so as to have French Guinea on the north, Liberia on the east and south-east; area, about 30,000 square miles. The surface near the shore, though sometimes rocky, is generally flat, but in the interior are many hills and mountains, varying in height from 500 to 3000 feet. Some parts are low and swampy; most parts are well watered. The soil, of which only a comparatively small portion is under regular cultivation, is very fertile, growing excellent crops of rice, Indian-corn, yams, plantains,

pumpkins, and cassava. Many of the West India products have been introduced; and sugar, coffee, indigo, ginger, and cotton thrive well. The fruits include the baobab, cocoa-nut, banana, pine-apple, orange, lime, guava, papaw, pomegranate, &c. The forests are extensive, and the trees in them are often so magnificent as to be converted into canoes capable of containing 100 men. The principal live stock are pigs and goats. Poultry also, particularly guinea-fowls, are very abundant. The fisheries both on the coast and in the rivers are productive. The chief industrial establishments are those in which the palm-oil is extracted and prepared. Boat-building is also carried on to some extent, native cloth is woven, and leather is dressed on a small scale. The trade is carried on chiefly with Great Britain. The total value of imports for the year 1900 was £558,271; of exports, £362,741. The total tonnage of vessels entered and cleared for the same year was 1,290,933 tons, of which 994,328 were British. The principal articles of import are cottons, wines and spirits, tobacco, apparel, haberdashery, flour, salt, &c.; of exports, palm-kernels, kola-nuts, gum copal, ginger, benniseed, &c. The total revenue in 1901 was £192,138, and the expenditure amounted to about £173,500. The strongest religious bodies are the Church of England and the Wesleyan Methodists. The number of white inhabitants is only about 350. Education is denominational, but is assisted by state aid. There are some 80 elementary schools, the number of pupils on the rolls being over 8000. There is a college at Furah Bay for the education of a native ministry, supported by the Church Missionary Society and affiliated to Durham University; secondary schools for boys and for girls at Freetown, a technical school, &c. Sierra Leone appears to have been discovered by the Portuguese in 1463; but it first became a British colony in 1787. Soon after, a company was formed with the humane intention of making it a home for free negroes, and proving by their means that colonial products could be raised without slave-labour. In 1800 a grant of the peninsula was made to the company, but in 1807 the company ceded all their rights to the crown. Since then the position of Sierra Leone has varied at different times. Its affairs are now administered by a governor and an executive council of several official members, with a legislative council. One great obstacle to its prosperity is the deadly nature of its climate, particularly to Europeans; but its progress, though slow, has been steady. The natives can live in comfort with little exertion. Freetown (pop. 25,000) is now a fortified coaling station and centre of trade. A railway runs inland for some distance. Pop. in 1891, 74,835; in 1901, 76,655; with protectorate, about 1,000,000.

SIERRA MORENA, a range of hills in Spain, stretching from north-east to south-west about 380 miles, and forming one of the principal systems of mountains in the peninsula. It separates the upper portions of the basins of the Guadiana on the north and of the Guadalquivir on the south, attaining in its highest point to 5500 feet above sea-level. It abounds in copper, zinc, quicksilver, iron, &c.

SIERRA NEVADA (Spanish 'Snowy Range'), a chain of mountains in Spain, the most elevated range in the Peninsula, which derives its name from the perpetual snow that covers its loftiest summits. It extends through Granada and Andalusia, from west to east, and terminates on the shores of the Mediterranean in several promontories, of which that of Gibraltar is the most remarkable. The highest peaks are those of Mulhacén, which has an elevation of about 11,678 feet; and Veleta, 11,378 feet. See GRANADA.

SIERRA NEVADA, a mountain range in the United States of America, which takes its origin in California about lat. 34° N., lon. 117° W., and after running north-westwards bends north, and forms the eastern boundary of the state. Among its most remarkable features are several grand volcanic peaks, which reach high into the region of perpetual snow, one of them reaching the height of 15,000 feet above the sea. The loftier peaks are of course destitute of vegetation, but both the plateaux from which they rise and their lower slopes are generally covered with magnificent forests. In various parts of this range are found immense deposits of gold quartz. The rivers San Joaquin, Sacramento, and other smaller streams have their source here.

SIEYÈS, EMMANUEL JOSEPH, better known as the Abbé Sieyès, was born at Fréjus in 1748, and being destined for the church pursued his studies at the University of Paris. At the commencement of the revolution he took an active part as a member of the clerical body in furthering its progress, and when the important question as to the mode in which the three estates were to vote was discussed Sieyès published three pamphlets, which, by the ability with which they advocated the popular view, brought him into very general and favourable notice. Though he seldom came forward as a speaker he soon acquired the greatest influence in the national assembly. With him originated the idea of a new geographical division of France into départements, arrondissements, and communes. He also took an active part in the formation of the new constitution, and was in 1791 member for the department of the Seine, but declined the honour offered him when the electoral assembly proposed to make him constitutional bishop of the capital. In 1792 he was deputy for the department of the Sarthe; but now aware of the personal danger attached to active participation in public measures, kept aloof, and generally contented himself with merely recording his vote. During the Reign of Terror he withdrew into the country, and when afterwards asked what he had done for his country at that fearful period simply answered, 'I lived,' deeming the preservation of life, in the circumstances, no small achievement. On the downfall of Robespierre he returned to the convention and took an active part in public measures, more especially foreign affairs, conducting several important negotiations with other states. In 1797 he narrowly escaped assassination from the Abbé Poulle, who, entering his room, discharged a pistol at him, and shattered his hand. In 1798 he went on a mission to Berlin, and succeeded in securing the neutrality of Prussia. On his return in 1799 he succeeded Rewbell as a member of the directory, and shortly after succeeded in displacing three of his colleagues, so as to obtain a majority favourable to his views. He afterwards, with the assistance of Fouché, closed the Jacobin Club. This measure made him very obnoxious to the extreme republican party, and under the conviction that faction was now to be kept down only by force he began to look out for a military leader. He thought of several, but fixed at last on Bonaparte as a fit associate for his designs. The revolution of the 18th Brumaire was the result; but Sieyès, who hoped he had only obtained a coadjutor, soon learned that he had subjected himself to a master. In the differences which ensued he found his speculations completely overmatched by Bonaparte's practical energy, and accordingly terminated his political career. He did not, however, retire unrewarded, but proved that the simplicity and disinterestedness of which he had boasted were more nominal than real, by obtaining, along with the title of count, grants of lands and other property to the

value of at least £50,000. He was called at the restoration, but returned on the July revolution of 1830, and died at Paris in 1836.

SIGHT, DEFECTS OF. One of the most common defects of sight is *shortsightedness* or *myopia* (Greek, *muō*, 'I close,' and *ōps*, 'the eye'), a defect in which objects are seen distinctly only at a range within that belonging to perfect vision. The range for normal vision is usually from 16 to 20 inches, and a person who cannot see an object distinctly beyond 10 inches may be regarded as shortsighted. In some the degree of shortsightedness is so great that they must regard the object at a distance of 1 or 2 inches only from the eye. The immediate cause of myopia is the convergence of the rays transmitted from an object at the ordinary distance of vision into a focus in front of the retina and at a greater or less distance from it, whence they proceed in a divergent state to the back of the eye, and then form confused nebulous spots in place of well-defined points. By bringing the object sufficiently near to the eye the rays converge upon the retina, and distinct vision ensues. By the use of a concave lens, which gives increased divergence to the pencils of light that enter the eye, the overpowerful refraction of the eye is compensated for, and the rays being carried with a just convergence to the retina, distant objects are seen with distinctness. The reason that the focus falls short of the retina in shortsighted persons is that either the cornea or the crystalline lens is too convex, or the humours of the eye generally are too dense or too abundant. It is a popular mistake to suppose that advancing age cures myopia: too frequently the reverse of this is true, and the defect progressively increases instead of diminishing. According to Donders (On the Accommodation and Refraction of the Eye, London, 1864) if it continues progressive 'the eye will soon, with troublesome symptoms, become less available, and not unfrequently at the age of fifty or sixty, if not much earlier, the power of vision is irrevocably lost.' The persons most subject to myopia are students and literary men, and in general those whose occupation requires the eye to be held very near their work. The use of a single eye-glass should be carefully avoided, as it may result in a permanent injury to one or both eyes; and when glasses are necessary it is always safest to consult an oculist in selecting them.—*Longsight* or *presbyopia* (*presbus*, old) is the opposite defect from shortsight, objects being seen distinctly only at a range beyond that belonging to perfect vision. The lenses in this case are deficient in refracting power, and unable to converge the rays within the limits of the eye-chamber, the image being therefore formed behind the eye. Presbyopia usually comes on with advancing age, but young people are sometimes afflicted with it. This defect can be remedied by the interposition of a convex lens, which gives to the pencils of rays so much convergence at their entrance into the eye as is necessary to assist the imperfect action of the lenses and produce perfect convergence on the retina. Both defects are illustrated at OPTICS, Pl. I., figs. 11 and 12.—*Double-vision* is when, as in some cases of squinting, each eye sees things separately; or it may result from muscular paralysis.—*Night-blindness* or *hemeralopia* is a peculiar defect by which a person becomes suddenly and entirely blind when night comes on, though he can see perfectly well in the daytime. See NIGHT-BLINDNESS. See also COLOUR-BLINDNESS.

SIGILLARIA, a genus of fossil plants found in great abundance in the coal measures. The plant occurs in the form of compressed stems attaining a height of 40 to 50 feet, and a breadth of 5 feet. The stem is seldom found preserved so as to show any

structure or even its cylindrical form; it generally occurs as a double layer of coal, showing on the outer surfaces longitudinal furrows due to the arrangement of the leaves on the stem, and at regular intervals the scars produced by the bases of the leaf-stalks. The roots are found preserved in the shale which forms the floor of all coal seams; they were originally supposed to be distinct plants, and have received the generic name of *Stigmaria*. No foliage of any kind has been found connected with the trunk. Some suppose *Sigillarias* to be allied to Tree-ferns, others to Conifers. King says that if in imagination we delineate a channelled stem of any height between 12 and 100 feet, crowned with a pendant fern-like foliage, furnished with wide-spreading fibrilled roots, and growing in some densely-wooded swamp of an ancient Mississippi, we will then have formed a tolerably close restoration of a *Sigillaria* growing in its true habitat.

SIGISMUND, German emperor from 1411–37, son of the Emperor Charles IV., was born in 1368, and on his father's death in 1378 obtained the Margraviate of Brandenburg, the possession of which had been secured to him by an arrangement made at Prague with his brother Wenceslaus. By his marriage with Mary, the daughter and heiress of Louis the Great of Poland and Hungary, he became heir-apparent to the throne of those countries; but on Louis's death in 1383 the Poles elected Hedwig, Mary's sister, as queen, while in Hungary, where Mary's mother had obtained the regency, the government was seized in 1385 by Charles of Durazzo. On his murder Mary was acknowledged queen, and in 1387 Sigismund was crowned king of Hungary. The refusal of the waywodes of Walachia to acknowledge his authority involved him in a war with Turkey. The campaign proved disastrous. Though supported by the German princes and the French knights Sigismund was defeated by Bajazet at Nicopolis in 1396, and obliged to flee into Greece. At a later period, on his return to Hungary, where his wife had meanwhile died, the nation rose against him, made him prisoner in 1401, and gave the throne to Ladislaus of Naples. Sigismund succeeded in escaping, and raised a powerful force, with which he reduced Hungary to subjection. His brother Wenceslaus was in 1400 elected German emperor, and had received Rupert of the Palatinate for his successor. On the death of the latter in 1410 Sigismund and Jobst of Moravia became competitors for the imperial throne, and obtained an equal number of votes. Jobst, however, having died in 1411, the other votes were given to Sigismund, who was crowned at Aix-la-Chapelle in 1414. One of his first efforts was to put an end to the schism which had broken out in the church by the claims of competing popes, and by the diffusion of the doctrines of John Huss, and with this view he took an important lead in the Council of Constance, which was opened in 1414. During its proceedings he disgraced himself by allowing Huss, to whom he had granted letters of safe conduct, to be put to death. He had afterwards cause bitterly to repent of his treachery. On the death of Wenceslaus in 1419 the Hussites refused to acknowledge his succession to the Kingdom of Bohemia, and it was not till 1431, when he signed the compact with the Council of Basel, that their opposition was withdrawn. The same year he proceeded to Milan, where he was crowned emperor. His coronation was repeated at Rome in 1433, and he was now in possession both of the imperial crown and the crown of four kingdoms. He did not live long to enjoy them, but died at Znaim in 1437. With him the Luxemburg dynasty became extinct.

SIGISMUND I., surnamed the Great, King of

Poland, 1506–48, born in 1467, was the youngest son of King Casimir IV., and obtained from his brothers the Duchies of Glogau and Oppeln in 1499, shortly after he had been named Duke of Lithuania. In 1506 he succeeded his brother Alexander on the throne of Poland. The people had great expectations from him, and he in a great measure fulfilled them by endeavouring to reign in peace, and to promote the weal of his subjects by wise economy and internal vigour, though the war with the Russians, who were brought forward by the Lithuanian prince Michael Gliniski, gave him employment throughout his whole reign. The signal defeat which the Russians sustained at Orsza, on the Dnieper (14th July, 1508), did not prevent Gliniski from taking Smolensk in 1514, and handing it over to the Russians, who continued to retain possession of it even after a second great defeat at Orsza (8th September, 1514). The peace of Poland was also disturbed by incursions of the Tartars, and of the Walachians under their hospodar Bogdan. With Sigismund's assent, his sister's son, the last grandmaster Albrecht, became heritable Duke of Prussia. On the other hand Poland was increased by the addition of Masovia. By his mildness and wise toleration the Reformation soon spread in Poland, and Protestantism became the prevailing religion both in Grand Poland and Polish Prussia. By the advice of the Emperor Maximilian I., with whom he had in 1515, along with his brother Ladislaus of Hungary, a conference at Vienna, and formed a friendly alliance, Sigismund, after the death of his excellent wife Barbara Zapolyka, married a daughter of the waywode of Transylvania by Bona Sforza of Milan, the daughter of John Galeazzo. This marriage was the cause of many misfortunes to Poland. The unprincipled and avaricious Italian soon secured for herself an influence in the government, sold the public offices, and at last placed the selfish Piotr Kmita at the head of the administration. In this way the king, during the last years of his government, lost the love of his subjects. He died at Cracow in 1548, and was buried there. He was possessed of great bodily and mental vigour, and proved himself a wise and good prince, and a zealous patron of learning. Under him the golden age of ancient Polish literature begins.

SIGISMUND II., AUGUSTUS, King of Poland, 1548–72, son of the former, born in 1520, was appointed king in 1529, in the lifetime of his father, and also in 1544 obtained the government of Lithuania. His mother, Bona Sforza, allowed him to grow up in luxury and effeminacy that she might be able to continue her influence during the government of her son; but his natural talent soon shook off those fetters, and even as regent he displayed a vigour and firmness which kept his factious nobility in subjection. Soon after his accession he made public the marriage which he had privately made with Barbara Radziwill, and which the diet, instigated by Bona, sought to dissolve. When by the revival of ancient laws he proceeded firmly in curtailing the powers of the nobility they endeavoured to depose him, and Bona herself, alarmed at the consequences of her misconduct, sought to avoid the storm by getting Barbara crowned at Cracow in 1550. The latter, however, died, probably of poison, in 1551, and Bona, universally hated, finally quitted Poland with immense treasures for Italy, where she was poisoned by her paramour in 1557. Under Sigismund the Reformation made great progress in Poland. Numerous senators, landed proprietors, bishops, and clergy exchanged the Romish faith for Protestantism. In 1563 he gave toleration to the different religious parties, and in 1572, at the diet of Warsaw, proclaimed universal religious freedom. The same

year he died at Knyszyn, and with him the Jagellon race became extinct.

**SIGISMUND III.**, King of Poland and Sweden, born in 1566, only son of John III., king of Sweden, and of the Polish princess Catharina, a sister of Augustus Sigismund II. When, by the extinction of the Jagellons in Poland, the prospect of succeeding to the Polish crown opened to him, his father caused him to be brought up as a Roman Catholic and instructed in the Polish tongue. After the death of Stephen Bathori he was invited, in 1587, to become king of Poland, and having sworn the *Pacta Conventa* was crowned at Cracow. The Poles were greatly disappointed in this last offshoot of the Jagellons. He was proud, self-willed, intent only on his own interest, without intellect or vigour. His principal aim was the extension of the Roman faith in Poland, and only a very few magnates had public access to the sovereign, who had hedged himself round by Jesuits. On the death of his father, John III., in 1592, he set out with reluctance to Sweden to take possession of the throne to which he had succeeded, and was crowned in 1594. On his return to Poland he was obliged to leave Sweden under the regency of his uncle, who was aspiring to be its sovereign, and ultimately reigned over it as Charles IX. Sigismund's refusal to give up the crown of which he was thus deprived involved Poland in a disastrous war with Sweden, which lasted for sixty years. The dissatisfaction of the Poles with Sigismund's government was extreme, but was kept in check by Zamoyiski, who, having assisted him in originally obtaining the kingdom, had ever afterwards continued to be his firm supporter. But on Zamoyiski's death insurrection broke out in several quarters, and more especially in Cracow, where the waywode Zebrzydowski took the field against him at the head of 100,000 men. Want of unanimity among the rebels enabled Sigismund to put down this insurrection, but the discontent of his subjects was still general, and manifested itself particularly by stormy discussions at the diets. Impelled by his bigoted attachment to Roman Catholicism, he endeavoured to put down every other form of religion by excluding all persons of any other communion from offices of honour; by placing education entirely in the hands of the Jesuits, under whom true science and literature rapidly sank; and even by resorting to more active forms of persecution, and pulling down great numbers of Protestant churches. He died at Warsaw in 1632.

**SIGNALLING** is the communication of messages by means of audible or visible signs to distances greater than can be reached by the human voice. The most perfect means of doing so consists in the use of electricity, but until the recent invention of wireless telegraphy the use of electricity required a more or less fixed connection between the place signalled from and the place signalled to. Flags of various shapes and colours, cones, balls, drums, movable arms or semaphores (as in railways), blasts of sound, flashes of light, and other signalling media have been adopted for different purposes. Signalling at sea according to the international code is mainly effected by flags, either singly or in groups, interpreted in accordance with the code-book. The present system is of gradual growth out of the earlier ones devised by Sir Home Popham (1803), Captain Marryat (1817), and others. The old international code introduced in 1857 was superseded by a new one in 1902. The latter was prepared by a committee appointed by the Board of Trade, and took its final shape after foreign governments had been consulted. The new code differs from the old one mainly in having a complete flag

alphabet, and in the substitution of three-flag signals for all the four-flag signals of the 1857 code, except in the names of places and of ships. The twenty-seven flags used in the code comprise the 'code flag' or 'answering pennant', hoisted before a code signal is given and as a sign that a signal has been understood; five pennants, denoting the letters C—G; two burgees, denoting A and B; and nineteen square flags, representing the other letters of the alphabet. Some of the alphabetic flags have special meanings when hoisted alone; thus, C means Yes; D, No. From the twenty-seven flags (using only one set) not less than 702 separate two-flag signals can be made, and to the greater number of these a definite meaning is attached in the code; thus, A over B means 'Abandon the vessel as fast as possible'; code flag over S, 'I want a pilot'. The number of three-flag combinations possible with the alphabetic flags is 15,600, thus affording scope for an immense variety of signals of all degrees of importance. PCJ, for instance, means 'You will find great difficulty in getting through the ice at —', the place being indicated by a following geographical signal. The code flag above two alphabetic flags gives latitudes and longitudes; under two flags, numbers. As already stated, in the new code four-flag signals are not used for general purposes. They may be used, however, in spelling words alphabetically; and as there is now a complete alphabet of flags, any word may be spelt in this way, but the code signals, having their own special conventional significations (all given in the code-book), are a means of more rapid communication. There are never more than four flags hoisted at once. When, owing to distance or the state of the atmosphere, the colours of flags cannot be made out, a system of distant signals must be resorted to. There are three systems of these in the code-book, so constructed that any one can be interpreted in terms of the elements of another, and all three in terms of the flag code. These systems involve respectively the use of (1) cones, balls, and drums; (2) balls, square flags, pennants, and wharfs; and (3) a fixed semaphore. A square flag is equivalent to a cone point upwards, a pennant to a cone point downwards, and a wharf or tied flag to a drum. The positions of the semaphore arm, numbered 1, 2, 3 on the opposite side from the indicator, and 4 on the same side as the indicator, represent the shapes of the first two systems. The code signals in all these systems denote things or meanings rather than words, and thus they can be interpreted by ships of all nations. For some purposes what is called the movable semaphore may be used, and the arms of this semaphore may be represented by flags waved by a man standing in a conspicuous place. In this case, however, the French have a different alphabetic code from the British. The Morse telegraphic code of dots and dashes may be used in signalling not only by the electric telegraph, but also in several other ways. The dot and the dash may be indicated by blasts of sound or flashes of light of about one second and three seconds duration respectively, but the excessive use of such signals is liable to lead to confusion. The movements of a hand flag, such as is used in place of the movable semaphore, may also be adapted to the Morse code. In an appendix to the International Code-Book particulars are given regarding sound signals to be made during fog, mist, falling snow, or heavy rain-storms on the whistle or siren and fog-horn (see FOG-SIGNALS); sound signals to be used by vessels in sight of one another; and distress signals, made by means of guns, explosives, fog-signals, flames, rockets, &c. Different nations have different systems of meteorological

logical signals, the most elaborate being that of the United States. For military purposes the field telegraph is extensively used, but the heliograph (see *HELIOSTAT*) is also in regular use.

**SIGNATURE**, in music, the sharps or flats placed after the clef at the beginning of the staff; also, the two or more figures placed over one another in the form of a fraction, or other sign employed to indicate the time or rhythm of the piece. See *MUSIO*—*Examples v. vii. and xii.*

**SIGNATURE**, among printers, a number or letter placed on the first page of each sheet of a book, to distinguish the sheets and serve as a guide to the binder. Figures are now mostly employed for signatures, but formerly letters were used, and when the number of sheets exceeded the letters of the alphabet, these were repeated with a figure attached, as 2 A, 2 B, 3 A, &c. Instead of 2 A, 2 B, &c., the old printers used A a, B b, &c. Hence arose such expressions as 'a book of two alphabets.' The position of the signature is generally at the right-hand side of the bottom of the page.

**SIGNET**, in England, one of the royal seals, used in sealing private letters and all such grants as pass the sovereign's hand by bill signed. It is always in the custody of the secretary of state for the home department. In Scotland the signet is the seal by which the royal letters and writs for the purpose of justice are now authenticated. The principal class of agents or attorneys in Scotland are called writers to the signet, or clerks to the signet, from their having been, it is said, originally clerks in the office of the secretary of state, by whom writs passing the signet were prepared. The duty of writers to the signet now is to prepare the warrants of charters of land flowing from the crown, to sign all summonses for citing parties to appear in the Court of Session, and almost all diligences of the law for affecting the person or estate of a debtor. They had at one time the exclusive privilege of acting as agents or attorneys in conducting causes before the Court of Session.

**SIGNING, SEALING, AND DELIVERY** of a deed, in English law, is the mode of executing a deed. The most important acts are, however, the sealing and delivery, signature not being indispensable, at least in certain deeds. The use of the seal in authenticating deeds, still retained in England, has been given up in Scotland, where simple subscription is sufficient. See *DEED*.

**SIGN-MANUAL, ROYAL**, the signature of the sovereign at the tops of bills or grants or letters patent, which are then signed with the privy signet or great seal, as the case may be, to complete their validity. There are some grants which pass through certain offices, as the admiralty or treasury, under the sign-manual only. The sign-manual consists of the initial letter of the sovereign's name, with the letter R (for *rex* or *regina*) added.

**SIGNORELLI, LUCA** (called also, from his birth-place, *LUCA DA CORTONA*), a celebrated Italian painter, was born about 1440, and studied first under Matteo da Siena, and then under Pietro della Francesca. He began to distinguish himself about 1472, and painted till 1512, or perhaps later. He holds an important place in the history of art as the first who applied anatomical knowledge to painting, and thus became the precursor of Michael Angelo. Signorelli painted in the Sistine chapel, at Arezzo, Città di Castello, Cortona, Perugia, and Volterra; but his greatest works are the magnificent frescoes in the chapel of the Madonna di San Brizio in the cathedral of Orvieto. The series comprises the History of Antichrist, the Resurrection of the Dead, Hell and Paradise. It was commenced by Fra Angelico about 1447, and finished by Signorelli between 1499 and

1504. These frescoes were studied by Canova, and by Michael Angelo, who did not disdain to copy some of the figures for his *Last Judgment*. Among his other works the most worthy of mention are the Madonna Enthroned, the altar-piece of St. Onofrio in the cathedral of Perugia; the Adoration of the Magi, now in the Louvre; the Annunciation, and a Madonna, at Volterra. Signorelli was a man of high character, and attained municipal as well as artistic honours. He spent his last years in retirement at Arezzo, where he died about 1525.

**SIGNS, ASTRONOMICAL.** See *SYMBOLS (ASTRONOMICAL)*.

**SIGNS, MATHEMATICAL**, symbols which indicate mathematical processes and conditions.  $a + b$ ,  $a - b$ ,  $a \div b$ ,  $a \times b$ , and  $a \sim b$  read  $a$  plus  $b$ ,  $a$  minus  $b$ ,  $a$  divided by  $b$ ,  $a$  multiplied by  $b$ , and the difference between  $a$  and  $b$ ;  $a > b$ ,  $a < b$ ,  $a = b$ ,  $a \approx b$ , and  $a \equiv b$  read  $a$  greater than  $b$ ,  $a$  less than  $b$ ,  $a$  equal to  $b$ ,  $a$  approximately equal to  $b$ , and  $a$  identical with  $b$ ;  $\int$  is the sign of integration;  $\therefore$  denotes *then* or *therefore*, and  $\because$  denotes *since* or *because*;  $\sqrt{a}$ ,  $\sqrt[3]{a}$ ,  $\sqrt[n]{a}$  represent the square root, the cube root, and the  $n$ th root of  $a$ .

**SIGOURNEY, MRS.**, whose maiden name was Lydia Huntley, an American authoress, was born at Norwich, Connecticut, 1st September, 1791. She received a good education. She showed considerable facility in rhyme at an early age, and many of her pieces were published in the periodicals of the day. For some time before her marriage with Mr. Sigourney in 1819, she had been engaged in teaching schools for young ladies. In 1815 she published a volume entitled *Moral Pieces in Prose and Verse*, which was quickly followed by other works, most of which enjoyed great popularity. Among her principal poems are: *Traits of the Aborigines of America*, *Zinzendorf*, *The Western Home*, and *Pocahontas*. Her prose works are mainly biographical, historical, didactic, and epistolary. In 1840 she visited Europe, and in 1842 gave some reminiscences of her visit in a volume entitled *Pleasant Memories of Pleasant Lands*. She died at Hartford, Connecticut, 11th June, 1865.

**SIGUENZA**, a town in Spain, in the province of Guadalajara, built in the form of an amphitheatre, on the side of a hill above the valley of the Henares, 72 miles north-west of Madrid. It is a place of considerable antiquity, and has a fine Gothic cathedral, a court-house in a large square adorned by a beautiful fountain, and surrounded by colonnades; a college and other schools, civil and military hospital, barracks, &c. Pop. (1887), 4930.

**SIGURD, or SIGURDR**, in northern mythology, the hero of the *Volsunga Saga*, on which the *Nibelungenlied* is based. According to the legend of the *Volsunga Sigurd* (the Siegfried of the *Nibelungenlied*) is the posthumous son of Sigmund, son of Volsung, a descendant of Odin; is born in the palace of Hialprek, king of Denmark, and grows up into a manhood as majestic as that of Phoebus. With his good sword Gram, which had once been wielded by Odin, he slays the dragon Fafnir, and obtains the golden treasure which it guarded; by eating the monster's heart he is endowed with a deep wisdom which enables him to understand the songs of the birds. Riding off with his spoil he strikes through a lonely heath, in the midst of which is a volume of flame, surrounding a house in which a fair maiden Brenhyldr (Brunhild in the *Nibelungenlied*), daughter of Atli, lay asleep, never to be awakened until there came a hero brave enough to ride through the fierce flame. Sigurd enters and wakes up Brenhyldr, to whom he plights his troth, and then rides to the palace of Giuki the Niflung, who wishes Sigurd to

marry his daughter Gudrun (Chriemhild). Gudrun's mother gives Sigurd a potion which causes him to forget Brenhyldr, and he marries Gudrun. Her brother Gunnar (Gunther), having determined to marry Brenhyldr, tries vainly to ride through the flames, and so his mother by her magic arts made Sigurd change shapes and arms with Gunnar, and so rescue Brenhyldr. On the bridal bed Sigurd places his sword between himself and Brenhyldr, and the following morning he resumes his shape, and hands her over to Gunnar. No sooner is this done than the power of the elixir passes off, and he sees when too late that he has betrayed his first love. After the lapse of years Brenhyldr is told that she was rescued from the flames by Sigurd, and not by Gunnar as she thought; and her love for the hero gives way to wrath and thoughts of vengeance. She urges Gunnar and his brothers to slay him, but as they had already taken an oath not to hurt him they refuse. They, however, incite their half-brother to do the deed, and Sigurd is killed as he lay sleeping. The death of the hero revives all the love of Brenhyldr, and lying down by his side with the sword Gram between them, she dies broken-hearted on his funeral pile. A close correspondence can be traced between this legend and the myths of Greece, and the brilliant life and early death of Sigurd reproduces with a certain degree of exactness the chief features in the myths of Apollo, Hercules, Achilles, Ulysses, and other heroes.

SIHON. See SIR-DARLA.

SIKHS, or SEIKHS (from a Sanskrit word meaning 'disciple'), a religious sect in Hindustan which professes the purest Deism. It is chiefly distinguished from the Hindus by worshipping one only and invisible God. It was founded by the estimable Nanak Shah, of the caste of Kshatriyas and the Hindu tribe of the Vedis, who was born A.D. 1469, in the village of Talwandi (now the town of Rajapur), in the province of Lahore. Nanak was early converted to monotheism, and after extensive travels through Hindustan, Persia, and Arabia, having visited Medina and Mecca, he became acquainted with the system of the Sufi, and adopted their doctrines. He read particularly the works of a Mohammedan named Kabik, belonging to this sect, who enjoined in all his writings universal philanthropy, and particularly religious toleration. Nanak now renounced all worldly business, and consecrated his life to the purest devotion. He entertained the idea of effecting a union between the Hindus and Mohammedans, by introducing simplicity of faith and purity of morals. Hence he treated both religions with respect, laboured to remove only what was superfluous and dissonant, and to lead the people to a practical religion, to a pure worship of God, and love to mankind. Thus he used to say, 'Hundreds of thousands of Mohammeds, millions of Brahmas and Vishnus, and hundreds of thousands of Ramas, stand before the throne of the Almighty, and they all die. God alone is immortal. He only is a good Hindu who is just, and a good Mohammedan whose life is pure.' Nanak died about 1540, at Kirtipur, where he lies buried on the banks of the Ravi. Hence Kirtipur is deemed a sacred place by the Sikhs, and a relic of Nanak's dress is preserved in his temple there, which is shown to pilgrims. The ennobling religion established by Nanak, and the benevolence of his doctrines, corresponded to the purity of his whole life. Far from deceiving his adherents with pretended miracles, he replied when importuned to perform a miracle, 'I have nothing worth showing. A holy teacher has no defence but the purity of his doctrines. The world may alter, but the Creator is unchangeable.' As a governor and priest he exercised during his life a spiritual

and temporal dominion over his disciples. At his death he transferred the power to a favourite disciple named Lehana, whom he had himself initiated into his doctrines, and dressed in the sacred garb of a fakir. Of his successors in the government of the Sikhs, Arjun-mal gave stability to the religion, and unity to its professors, by collecting the writings of Nanak, and publishing them with his own explanations in the *Adi Granth*, the first sacred book of the sect. By this time the Sikhs had entirely rejected the authority of both the Koran and the Vedas, and so aroused the enmity of the Mohammedans as well as the Brahmins. Arjun-mal was thrown into prison, where he died. Eager to avenge his father's death, Har Govind, the son and successor of Arjun-mal, transformed the Sikhs from peaceful believers into valiant warriors; and under his reign, and that of his posterity, a bloody contest was maintained between them and the Mohammedans. Govind Singh, or Singh, the tenth head of the Sikhs from Nanak, was the real founder of the Sikh state. He abolished the Hindu distinction of castes, and gave equal rights to the lowest *Sūdra* and the highest Brahman. This procured him great accessions to the numbers of his disciples, whom he excited to seek for happiness in this and the future world by destroying the tyrannical Mohammedans. From this time, in consequence of their heroic conduct during the protracted contest with their oppressors, Govind Singh's followers received the title of *Sinhs* or *lions*, which before had been confined to the *Rajputa*, as the first military order among the Hindus. This ruler, equally great as a soldier and a lawgiver, wrote the *Dasema Padshah ke Granth*, or the book of the tenth prince (so called because he was the tenth 'teacher' or guru of the Sikhs from Nanak). Besides treating of religious subjects it contained also the history of the author's exploits. It is regarded by the sect with the same veneration as the *Adi Granth* of Arjun-mal. Govind Singh directed the Sikhs, in order to distinguish them for ever from Mohammedans and Hindus, to wear a blue dress, to let their hair grow, and to be always armed. To make his religious institutions more stable he founded a religious order, the *akalis* (immortals), and assigned the members of it a *banya* (monastery) by the sacred fountain at Emouiser, on the income of which they were supported. To these *akalis* he committed the care of converting and initiating new Sikhs, and in their hands still rests the supreme direction of all the religious affairs. Govind Singh, who died in 1708, was the last head of the Sikhs; for a prophecy limited the number of the rulers to ten, and as he was the tenth ruler after Nanak he said to his friends on his death-bed, 'I commit the state to God, who never dies.' Hence the Sikhs suppose that they are under the peculiar care of the Deity. After the death of Govind Singh the Sikhs gradually yielded to the superior power of the Mohammedans; and even Banda, one of their most heroic leaders, after a fearful struggle, was taken prisoner in the fort of Lagab, with all his followers, sent to Delhi, and put to death with the most barbarous tortures. To exterminate at length the hated sect a price was set upon their heads by the Mohammedan government, and every adherent of it who could be taken was put to death. But they suffered with the greatest firmness the pains of martyrdom, often courting rather than fleeing from them. Nothing could induce them to renounce their faith; and a Mohammedan writer has stated that no Sikh was taken on the pilgrimage to Amritsar (the holy place of the Sikhs) who ever abjured his religion to save his life. A very small number of the Sikhs escaped to inaccessible mountains, and faithfully preserved the doctrines of their fathers, and an inex-

tinguishable hatred towards their persecutors. After Nadir Shah's return to Persia they ventured to leave the mountains; and taking advantage of the confusion into which Nadir's expedition had plunged Hindustan, they subdued all Lahore. In course of time the Sikhs became broken up into a number of independent communities, each governed by a *sirdar*, and between these almost incessant hostilities were carried on. One of these sirdars, Maha-Singh, acquired a preponderating influence among the rest, and after his death in 1792 his son Runjeet Singh succeeded in establishing himself as despotic ruler of the Sikhs, with the title of Maharajah. His capital was Lahore, and the territory over which he ruled received the same name. The territory of the Sikhs, in its fullest extent, reached from 30° to beyond 34° N., comprehending the whole Panjab, part of Multan, and most of the country between the Jamna and Satlej, or the north-west corner of Hindustan; total area, 69,000 square miles. Runjeet Singh died in 1839, and his dominions immediately fell into confusion. After a series of outbreaks, palace revolutions, and crimes, a widow of his succeeded in securing the supreme power to her son Dhulip Singh, a minor. In 1845 the Sikh forces took the field against the British, and having crossed the Satlej, attacked the latter, who were commanded by Sir Hugh Gough, Dec. 18, at Mudki. Here they were repulsed, and again being defeated three days after at Ferozeshah in a battle lasting two days (21-22 Dec.), had to recross on the 27th. Jan. 20, 1846, the Sikhs having again crossed the Satlej, were attacked by Sir H. Smith near Aliwal, and after a severe contest routed. On the 10th February another great battle was fought at Sobraon, which resulted in the defeat of the Sikhs. The British were commanded by Sir Hugh Gough. Feb. 20, the Maharajah of Lahore, having made his submission, was conducted to his capital by the British. March 20, a treaty was signed, by which the citadel and city remained in our possession. Soon thereafter the maharajah died, leaving a boy seven years old to succeed him. In 1848 the province of Multan revolted, and the insurgents, under the dewan Moolraj, murdered two British commissioners. As this was considered but the first signs of a general outbreak a small force of native and European troops, under Lieutenant Edwards, supported by a body of friendly Sikhs under the Rajah of Bhawalpur, was despatched to attack the insurgents. Edwards came up with the army of Moolraj strongly posted on the salt hills of Nunar on June 18, and after a severe struggle defeated it. Both armies having received reinforcements, another battle was fought with the like result on July 1, at Suddusam, and Moolraj was driven into Multan. This place was immediately laid siege to, and was on the point of being stormed when the defection of 5000 auxiliary Sikhs, under Shere Singh, compelled the British to retreat. The siege was, however, resumed on December 17, and the place taken on January 22, 1849. Meanwhile an insurrection in Hazareh, under Chuttur Singh, father of Shere Singh, after a slight check, assumed large dimensions, and threatened to become still more formidable in consequence of the alliance he had formed with the Afghans. It was now impossible to doubt that the Sikhs as a nation had resolved on a decisive struggle, and the British commander-in-chief, Lord Gough, advanced with an army against Shere Singh, who was concentrating his forces in the vicinity of Ramnagar, on the left bank of the Chenab. After some severe fighting, which lasted for several days, the Sikhs were driven from this strong position (3d Dec. 1848), but their strength yet remained unbroken. Gough again came up with them at Chillianwalla, 13th Jan. 1849, but

attacking them in too great haste received a severe check. The two armies, now both reinforced, again came into collision on the 21st February at Gujrat, where the power of Shere Singh and his allies was completely broken. On the 29th March the Governor-general of India proclaimed that the Sikh dominion was at an end, and that the Panjab had been annexed to the British Empire in India.

The bulk of the Sikhs are of Jât origin, and would therefore, according to some authorities, be descended from the ancient Getae. Intermingled with the true Sikhs are a number of other Hindus and a considerable number of Mohammedans. Physically the Sikhs are highly endowed, being finely formed, and possessed of great powers of endurance, as well as courage. The Sikh population of India was stated at 1,907,836 in 1891, of whom 1,870,000 were in the Panjab alone.

SI-KIANG, or WEST RIVER, China, by far the most important of the streams which unite to form the Canton River. It was thoroughly explored up to the eastern frontiers of Quangsee by a British gun-boat squadron, and was found to be navigable for vessels drawing 12 feet 75 miles from the sea. It is also called the Blue River, from the remarkable purity and clearness of its waters. By it are conveyed the sugar-canes that grow in the vicinity, as well as the rafts of timber from the forests of Quangsee to the markets of Canton.

SIKINO (ancient, *Sikinos*), an island of the Cyclades, in the Grecian Archipelago, between Nio and Polycandro; greatest length, north-east to south-west, 10 miles; breadth, about 3 miles. It has a lofty and often mountainous surface, but the soil is fertile. The staple product is excellent wine. Its chief town, of same name, is perched on a giddy precipice overhanging the sea.

SIKKIM, a rajahship under British protection, in North Hindustan, bounded on the north by Tibet, east by Bhotan, south by the plains of Bengal, and west by Nepal; greatest length, north to south, 80 miles; breadth, 60 miles; area, 1670 square miles. It forms a southern section of the Himalaya, and consists of a series of mountain ranges, which, rising abruptly from the plains 6000 to 10,000 feet, increase as they proceed north till they rise in Kanchinjanga to 28,156 feet. The mountains are separated by precipitous ravines and narrow valleys, each occupied by a mountain torrent. The largest river is the Teesta, which, like the rest of the drainage, belongs to the basin of the Ganges. The strata consist chiefly of granite, strangely contorted gneiss, mica and chlorite slate, porphyry, and sandstone. The climate is remarkable for its humidity, and where lowest is very unhealthy; but at 4000 feet, above which all the villages are built, is salubrious. The vegetation is very luxuriant, most of the mountains being clothed with magnificent forests. Large cinchona plantations have been made by the British. The soil raises good crops of millet, maize, and rice. The aboriginal inhabitants are Lepchas, with marked Mongolian features and a language radically Tibetan. They live chiefly on rice, but delight in all kinds of animal food. Pop. (1891), 30,458.

SILENE, a genus of plants belonging to the natural order Caryophyllaceae. It has a tubular, naked, five-toothed calyx; five notched or bifid petals, which are usually crowned in the throat with five bifid scales; ten stamens; three styles; capsule three-celled, six-toothed, and many-seeded. The species are in general herbaceous, many annual, very few shrubby. Their stems are leafy, jointed, branched, and frequently glutinous below each joint. The calyx and leaf-stalks are also frequently viscid, hence the popular name Catch-fly, applied to many

of the species. Some of them give off a delicious scent, especially at night. The greatest proportion of the numerous species which make up this genus inhabit the south of Europe and the north of Africa. Moss Campion or Stemless Catchfly (*S. acaulis*) is found on nearly all the Scotch mountains, and on the highest hills of Devon and Cumberland. Its flowers are of a beautiful purple colour, and it is one of the greatest ornaments of our Alpine flora. Bladder Campion (*S. inflata*) is a common plant throughout Europe, and abounds in almost every field and wayside in Britain. It has a branched stem about 1 foot high, ovate-lanceolate bluish-green leaves, panicles of white flowers, and an inflated calyx with a beautiful net-work of veins. The cultivation of this plant has been recommended on account of the edible properties of the young shoots, which may be used like asparagus.

SILENUS, the constant companion of Bacchus. He educated Bacchus, and instructed him in the sciences. He loved the inspiring beverage of his pupil's invention so well that he was generally intoxicated. A whole race of Sileni sprang from him. They are represented with a curly beard, a low forehead, and a bald head. Silenus is known from the rest by the cantharus or bottle which he bears. He is often also distinguished from the other Sileni by being mounted on an ass, or by his accompanying Bacchus, and is frequently represented holding the infant Bacchus in his arms. He sometimes also appears treading out grapes, and covered with hair. In the latter case a caricature is intended.

SILESIA (in German, *Schlesien*), formerly a duchy belonging to Bohemia, now divided politically between Prussia and Austria, and geographically into Upper and Lower Silesia. The Prussian province of Silesia (15,556 square miles; pop. 4,668,857) borders on Posen and Poland to the east, on the Austrian territories to the south, and on Saxony and Brandenburg to the west and north. The southern part of the province is mountainous, being intersected by different ridges of the Sudetic chain. Towards Brandenburg and Posen it is level, but in part marshy and sandy, although throughout adapted to tillage. The principal river is the Oder, navigable as far south as Ratibor. The soil of Silesia is fertile, yielding corn of all sorts, fruits, and tolerable wines. The mountainous parts are covered with wood, or afford good pasture and meadow land. Flax is raised in large quantities, and affords an important article of manufacture and trade; and madder, hemp, hops, and tobacco are among the productions of the province. The wool of Silesia is of the best sort produced in Prussia. Among the mineral productions are iron, copper, lead, some silver, sulphur, coal, vitriol, &c., and there are mineral waters in several places. Linen is the principal article of manufacture. Cotton and woollen goods and leather are also manufactured to a great extent. Silesia is divided into three governments—Breslau, Liegnitz, and Oppeln. The inhabitants are chiefly Lutherans and Catholics in nearly equal proportions, with some Calvinists, Hussites, Herrnhuters, Jews, &c. There is a university in Breslau, the capital of the province, with two theological faculties, one for Catholics and the other for Protestants, and numerous gymnasia, or high schools, in the large towns.

Silesia was inhabited at the beginning of the Christian era by the Lygii and Quadi, who, along with the other Germanic tribes, pushed westwards about the sixth century, leaving this province to be occupied by the Slavs. It formed part of the Slavic kingdom of Moravia, was afterwards joined to Bohemia, and in the beginning of the tenth century was annexed to Poland. It became independent in

1163, and was at first governed by a triumvirate of dukes of the royal house of Piast. These princes, to repeople the territory which had been wasted by sanguinary civil wars, encouraged the settlement of German colonies, especially in Lower Silesia. The numerous descendants of these three dukes divided and subdivided the paternal dominions to such an extent that at the beginning of the fourteenth century seventeen independent dukes reigned in Silesia at one time, and ruined the country by the feuds they kept up against each other. In order to escape the grasp of Poland it acknowledged the sovereignty of the Bohemian kings. In 1537 the Duke of Liegnitz, one of the numerous petty rulers, entered into an agreement of mutual succession with the Elector of Brandenburg on the extinction of either line, and on the other ducal lines becoming extinct their possessions fell to Liegnitz or to Bohemia, or lapsed to the Emperor of Germany. In 1675 the ducal line of Liegnitz died out, and the emperor, refusing to recognize the agreement of 1537, took possession of the territories of Liegnitz, Brieg, and Wohlau, as a lapsed fief of Bohemia. In 1740 Frederick II. of Prussia laid claim to certain portions of Silesia, and took possession of the province; and in 1763, at the close of the Seven Years' war, Silesia was finally ceded to Prussia.

Austrian Silesia consists of the southern part of the old Silesian duchy, which was left to Austria by the Peace of Hubertshurg in 1763. It was divided into the circles of Teschen and Troppau, and attached to the Moravian *gubernium* of Brünn; but by the constitution of 1849 was erected into a separate crown land, and divided into seven districts. Pop. 680,529; area, 1988 square miles. It is mountainous, and although the soil is not in all parts favourable, it is rendered productive by the industry of the inhabitants, who are also extensively engaged in linen, cotton, and woollen manufactures.

SILHET, or SYLHET, a town of Hindustan, in Assam, capital of a district of the same name, on the right bank of the Surmah, 270 miles north-east of Calcutta. It is pleasantly situated on a slight elevation, accessible in the wet season only by boats. The houses of the Europeans are built on hillocks, surrounded by fine spreading oaks. The chief articles of trade are lime and a long sedge used for thatching. Pop. 16,846.—The district, area 5440 square miles, consists of broad flat valleys, annually submerged, and ranges of hills, which, in the north, rise into mountains. Among these many remarkable fossils have been found. The Surmah receives most of the drainage. Coal has been found, and chunam (a kind of fine lime) exists in beds apparently inexhaustible. The principal crop of the low grounds is rice; in the higher districts cotton and sugar are produced to a limited extent; fruit is abundant, particularly oranges and limes, and tea is successfully cultivated. Pop. (1891), 2,154,598.

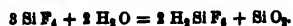
SILHOUETTE is the representation of the outlines of an object filled with black colour, in which the inner lines are sometimes slightly drawn in white. The name comes from Étienne de Silhouette, French minister of finance in 1759. He strove by severe economy to remedy the evils of a war which had just terminated, leaving the country in great exhaustion. At the end of nine months he was obliged to leave his place. During this period all the fashions in Paris took the character of parsimony. Coats without folds were worn; snuff-boxes were made of plain wood; and, instead of painted portraits, outlines only were drawn in profile, and filled with Indian ink, &c. All these fashions were called *à la Silhouette*; but the name remained only in the case of the profiles, because the ease with which they may be

drawn, or cut out of black paper, makes them popular, though, considered as works of art, they have little value. Some faces—those with a marked profile—are easily taken in this way; whilst others lose their character entirely, particularly those whose traits are well harmonized. These representations may be taken very well from the shadow of a person on a paper held on the wall; and, in order to make the shadow more steady, it is well to rest the head on a book or the like, put between the face and the paper. The paper is then cut according to the outline of the shadow, and the outer surface pasted on black paper. The likeness can be taken still better, and of any size, by means of an instrument called a *pantograph*.

**SILICA**, a compound of oxygen and silicon, forming one of the most frequently occurring substances in the materials of which this globe is composed. It occurs either in a crystallized form or in amorphous masses. Silica forms a principal ingredient in nearly all the earthy minerals, and was regarded as one of the primitive earths until the discovery of the composition of the fixed alkalies by Davy, when it was ascertained by this philosopher to consist of oxygen and an unknown base, to which the name of *silicon* or *silicium* has been given. If we ignite powdered quartz with three parts of pure potash in a silver crucible, dissolve the fused compound in water, add to the solution a quantity of hydrochloric acid sufficient to saturate the alkali, and evaporate to dryness, we shall obtain a fine gritty powder, which, after being well washed with hot water, and ignited, is pure silica. Silica is the only compound of silicon and oxygen with which we are acquainted. It consists of these elements in the proportion expressed by the formula  $\text{SiO}_2$ . It is a white, tasteless powder, feeling gritty between the teeth, and having a specific gravity of 2.65. When originally formed by the combustion of silicon, it is so soluble in water that the liquid, when concentrated, gelatinizes. But after it has been exposed to heat it loses its solubility altogether. When silica is mixed with thrice its weight of potash, or with a quantity of carbonate of potash containing thrice as much potash as the weight of silica employed, and the mixture is exposed to a strong heat, it fuses, and assumes, on cooling, the appearance of glass. This glass, which consists of silicate of potassium, dissolves in water. If to an aqueous solution of it we add as much hydrochloric acid as will saturate the alkali, and concentrate the solution sufficiently, a white jelly-like mass of silicic acid is produced. Silicic acid thus formed may be separated from the liquid in which it is suspended by dialysis. If we evaporate the whole to dryness, and wash off the salt of potash from the dry mass, the silica remains behind in the state of a very fine powder. Silica may be subjected to a very violent heat without suffering any change; there is no difficulty in causing it to melt, however, before the compound blowpipe. Silica occurs in nature in the amorphous state as opal, and in the crystalline form as quartz (which see). Silica forms a number of hydrates, which have acid properties, and from which a vast number of salts are obtained. The silicates form a most important class of minerals, in which are included clay, garnet, beryl, meerschaum, talc, serpentine, &c. &c. By heating the double fluoride of silicon and potassium with metallic potassium, and washing the product with water, a dark-brown amorphous powder is obtained. This powder is *silicon*. It has the property of soiling the fingers when touched; it is not acted on by nitric or sulphuric acid, but is easily dissolved by hydrofluoric acid; when very strongly heated in a non-oxidizing atmosphere it fuses, but when heated in oxygen it is turned to silica. The element silicon

can be obtained in the form of crystals by dissolving it in molten aluminium. The formation of crystalline silicon is best brought about by passing vapour of chloride of silicon over aluminium which is kept fused in an atmosphere of hydrogen; part of the aluminium is converted into chloride, while another part dissolves the reduced silicon; the amount of silicon gradually increases until it can no longer be held in solution by the aluminium, whereupon it is deposited in the form of dark iron-gray needles, which appear of a reddish colour by reflected light. These crystals are very hard. This variety of silicon is known as *crystalline* or *adamantine silicon*.

Besides the oxide, silicon forms a number of compounds. *Chloride of silicon* ( $\text{SiCl}_4$ ) is a colourless liquid, boiling at  $50^\circ \text{C}$ ., which is produced by passing chlorine over an intensely heated mixture of silica and charcoal made into a paste with oil. *Fluoride of silicon* ( $\text{SiF}_4$ ) is a gaseous compound, produced by the action of hydrofluoric acid upon silica. In the etching of glass part of the silica is removed in the form of this body, fluoride of silicon. If the gas be conducted into water it is instantly decomposed, with the production of silica and an acid called *silicofluoric* or *hydrofluosilicic* ( $\text{H}_2\text{SiF}_6$ ), thus:—



In its general chemical analogies silicon closely resembles carbon; thus it forms a hydride ( $\text{SiH}_4$ ), a chloride ( $\text{SiCl}_4$ ), and an ethide ( $\text{Si}(\text{C}_2\text{H}_5)_4$ ); the silicon analogue of chloroform ( $\text{SiHCl}_3$ ) is also known, and a great many compounds in which silicon plays an exactly analogous part to carbon.

**SILICATE OF MANGANESE.** See **SILICATES**.

**SILICEA**, **SILICEOUS**, or **VITREOUS SPONGES**, the name applied to Bowerbank's order of the class Spongida, including those sponges in which the skeleton or hard parts are of 'solid, laminated, and continuous siliceous (or flinty) fibre.' See **SPONGE**.

**SILISTRIA**, or **SILISTRA**, a town of Bulgaria, on the right bank of the Danube. It is of a semicircular form and of great strength, having regular fortifications of solid masonry, important outworks, and an admirably constructed citadel; but consists in general of narrow, winding, ill-paved, dirty streets, and mean houses, mostly of wood. The principal buildings are several mosques, a large Greek church, public baths, and a custom-house with extensive magazine attached. The manufactures are insignificant, but there is an important trade. Silistria successfully resisted the Russians in 1773 and 1809, but was taken by them in 1829. In 1854, with a garrison of 15,000, it made a successful defence against the Russians, who numbered 60,000 to 80,000, and after a siege of thirty-nine days retreated with the loss of 12,000 men. It was invested by the Russians in 1877, and evacuated by the Turks in February, 1878, after the armistice. Pop. (1900), 12,133.

**SILIUS**, **CAIUS**, surnamed *Italicus*, was born in the reign of Tiberius, about the year 25 A.D. The place of his birth and the origin of his surname is uncertain. At Rome he applied himself to the bar, and became a celebrated orator and advocate. He was consul at the time of Nero's death, and incurred some reproach for assisting in that tyrant's prosecutions, but acquired honour from his conduct in the proconsulate of Asia, assigned to him by Vespasian, from which he retired into private life, and collected books, statues, and busts of eminent men. He finally retired to his seat in Campania, where, being seized with an incurable ulcer, he put an end to his life by starvation in his seventy-fifth year. The only work of Silius which has reached modern times is an epic poem on the second Punic war, in sixteen books, written with more diligence than genius. It con-

tains, however, occasional splendid passages, and his description of the passage of Hannibal across the Alps is particularly admired. There are editions by Drakenborch (1717, 4to), Ruperti (Göttingen, 1795-98, two vols. 8vo), and Bauer (Leipzig, 1891-92).

SILK, the peculiar glossy thread spun by the caterpillars or larvæ of certain species of Moths, and a well-known kind of fabric manufactured from it. The chief silk-producing larvæ belong to the family of the Bombycidae, of which group the common and only domesticated Silk-moth (*Bombyx mori*) is the most familiar species. This family of Moths is distinguished by the small size of the proboscis, or 'antlia,' and of the palpi; by the thick, hairy body; and by the large, broad wings. Besides the genus *Bombyx* the genera *Attacus* and *Oiketicus* are included by entomologists in this family. The *Bombyx mori* possesses a short body, stout legs, and white wings, which are marked by several black lines stretching across them, and running parallel with the wing-borders. The eggs are deposited in summer by the female moth on the leaves of the mulberry-tree (*Morus alba*), and these leaves also form the food of the future larvæ. The eggs are of a grayish tint, and may be preserved for considerable periods in a perfect state, damp being the chief enemy against which the silk-cultivator has to contend. The temperature at which the eggs ought to be kept must not vary many degrees from 55° Fahr. The eggs are preserved by being tied up in flat packages, containing about an ounce each. For hatching they are placed in a room heated gradually by a stove up to a temperature of about 80°. In the course of eight or ten days the eggs are hatched. The larvæ are now covered with sheets of paper on which leaves of the mulberry-tree have been spread. The sheets of paper are perforated with numerous small holes, through which the caterpillars make their way up to the mulberry leaves, their natural food. The leaves soon become covered with caterpillars, and are now carried off the sheets of paper, and laid upon shelves of wicker-work covered with brown paper. This is repeated twice a day until all the hatched larvæ are laid on the wicker-work. In a well-appointed nursery this ought to be completed in from two to three days. Great care and attention is required on the part of the attendants to keep the room at a proper temperature and well ventilated, and to supply the larvæ at proper intervals with fresh leaves, with as little trouble to the animal as possible, as the silk-worm is remarkable for its indisposition to move from its place—a circumstance which greatly lessens the labour of the attendants. The technical name of 'seed' is given to the eggs when they are preserved in packages, as already described. When the larvæ or 'worms' are first hatched they are of black colour, and are about  $\frac{1}{2}$  inch in length. At their birth they are carefully separated from the egg-cases, and placed in the proper situation for obtaining their suitable food. In the larval or caterpillar stage the insect passes from six to eight weeks, and during that period exemplifies at four different periods the process of 'ecdysis,' or that of moulting its skin—a process necessitated by the rapidly increasing size of its body; for at the close of its larval or worm-like stage it has attained a length of about 3 inches and a proportionate weight. The first skin is cast about the tenth day of its existence. It is extremely interesting to watch the several steps in the process of moulting. In order to diminish the action of the old skin upon the new skin, the insect exudes a lubricating humour between them, which renders them more easy of separation. Small silken threads are likewise emitted, which bind the skin to the spot

on which it now rests. These acts call forth considerable exertions, and after they are performed the larva rests quietly for a little to recover its energy. It now rubs its head among the leafy fibres surrounding it, and breaks through the skin of the head, then its front legs, and afterwards the whole body. On examining the cast skin it will be found that the covering has been thrown off the animal entirely, even to the jaws and teeth. Sometimes the outer skin is not entirely detached, in which case the animal generally dies. In five days after the first moulting the worm has acquired considerable size, being now generally about  $\frac{1}{4}$  inch long, at which period it again sickens, and a second moulting takes place. In five days more it has acquired the length of  $\frac{3}{4}$  inch, and a third moulting is effected. In five days more the worm casts its fourth and last skin, having increased in length to about 2 inches. It now devours much food, and increases greatly in magnitude for ten days, when it has reached its full growth.

The insect at the end of its larval stage consists of twelve apparent body segments; six true legs—the legs of the future moth—exist anteriorly, whilst ten fleshy legs, or 'prolegs,' as they are termed, provided with hooks, exist on the hinder segments of the body. The mouth is large, and furnished with powerful jaws. Nine spiracles, or breathing-holes, exist on the sides of the body; and seventeen ocelli, or simple eyes, exist on the head-segments. At this period of its life the creature begins to exhibit signs of languor. It no longer desires food, it voids its excrement in large quantities, and appears to decrease in bulk.

Twigs of broom or green oak are now laid on the wicker frames, and the worms are placed more closely together. The spinning process now commences. The worm throws its head about in various directions and spins the floss or outer net-work of its cocoon, and then winds the silk thread round its body as regularly as a spinner builds the thread upon the cop. The matter from which the silky thread is formed exists as a glutinous secretion, formed by two tubular glands named *sericteria*, which open on the lower lip (*labium*) of the larva, in a prominent nipple-like aperture termed the *spinneret*. The glutinous secretion pressed from the *sericteria* becomes of a more tenacious and thread-like consistence on being brought in contact with the air, and the two filaments of the *sericteria* become united as they issue from the spinneret, apparently by the glutinous secretion of another and special gland. The work of spinning the *pupa-case* or *cocoon* occupies from three to five days.

If left to itself the larval form becomes the nymph or chrysalis in the interior of its cocoon, and after passing about three weeks in this stage emerges from the cocoon as the perfect moth or *imago*. But save for the purpose of reproduction the insect, when destined to afford the valued silk material, is not allowed to enter the imago state. On completing the manufacture of its cocoon the latter structure with its contained larva is thrown into warm water, which dissolves the glutinous matter cementing the threads together, and renders the operation of unreeling the silk—to be presently described—readily performed. The silken thread furnished by a single cocoon may measure from 750 to 1150 feet in length. A good average length is 300 yards. About 12 lbs. of cocoons yield 1 lb. of raw silk, and 1 oz. of silk-worms' eggs will give 100 lbs. of cocoons; whilst 16 lbs. of mulberry leaves will suffice to produce 1 lb. of cocoons. Each average mulberry-tree yields about 100 lbs. of leaves. It may thus be calculated how much material—insects, eggs, leaves, &c.—is necessary to produce the annual amount of 8,000,000

lbs. of silk required in Britain alone. The number of eggs produced by the female moth varies from 200 to 500, and about 200 cocoons will give 1 oz. of 'seed' eggs.

Practical cultivators recognize nine varieties of cocoons. The best are the *bons cocons*, which are compact, shapely, and free from spots. The second quality are the *cocons pointus*, or 'pointed' ones, which are known by having one end elevated into a point. These have a weak thread, liable to break at the pointed part, and they consequently cannot be unwound beyond this part. *Cocons faibles*, or 'weak' cocoons, are of larger size than the perfect ones, and their texture is less compact, the silk being, as it were, more loosely rolled, and liable to entangle in winding. *Cocons doubles*, or 'double' cocoons, form the fourth variety. These latter have mixed threads, and cause much confusion and frequently break in reeling. The fifth quality are the *cocons satinés gous-floons*, or 'flossy' cocoons, which are of loose fluffy texture, often transparent, and cannot be reeled. The *cocons ouverts*, or 'open' or 'perforated' cocoons, are those from which the moth or imago has escaped; but as the moth does not apparently break, but merely pushes aside the threads of the cocoon, this variety has been of late utilized by the use of means specially adapted for the careful unwinding of the thread. Those named *chiques*, or *cocons chiques*, are incomplete, and are occupied by dead insects. They are known by shaking them, when the worm, still adhering to the cocoon, does not make a rattling noise. *Cocons tachés* are imperfect, decayed, or badly spotted ones; and *dragées*, or calcified cocoons, are the cocoons of those larvae which have succumbed to the attack of the dreaded disease known as *muscardine*—a lesion of fungoid nature produced by the growth of a fungus named *Botrytis Bassiana*, the effects of which are to render the worm hard and calcified, whilst at other times it reduces the larva to a white powder. The silk of *dragées* is generally of excellent kind, and is present, it is said, in even greater quantity than that of healthy larvae.

The conditions which are favourable to the perfect and successful cultivation of the *Bombyx mori* are, firstly, that of having vigorous, healthy mulberry-trees. The *Morus alba* is the favourite European species of mulberry. *M. alpina* is also a favourite; and *M. japonica*, with large leaves, has lately been introduced from Japan. *M. nigra* is found growing well at the Cape of Good Hope, but grows too slowly to be much used. *M. Moretti* is a favourite Italian species, as also is *M. multicaulis*—with a large thin leaf—from the Philippine Islands. A mulberry plantation should not be touched until after its third year of growth. The *magnaneries*, or worm-nurseries, should be well ventilated, lighted, and maintained at an equable temperature. The purity of the eggs, and their absolute freedom from disease, forms a third point of importance in silk-worm cultivation.

Of the many diseases to which the silk-moth's eggs and larvae are subject none have assumed a greater importance than that known by the name *la pébrine*. Before 1853 this disease, marked by the appearance of black spots on the skin of the caterpillar, had attracted attention, and it progressed so rapidly and so fatally that in 1858 the silk produced reached only a third of the amount of 1853. The results of this malady were to ruin many cultivators, and to threaten to destroy in a serious manner the prosperity of the chief commercial industry of South France. In 1858 the French Academy deputed Quatrefages to report on the malady, and this naturalist, in his *Études sur les Maladies actuelles des Vers à Soie*, imagined that it resembled the cholera visitation of human kind. Filippi discovered multitudes

of small corpuscular bodies about the mouth of an inch in diameter in the blood of the affected larvae; and finally M. Pasteur, so well known for various discoveries in regard to bacteriology, asserted his belief that the corpuscle element of Filippi, or *Pankistophyton*, as it was termed, was the sole cause of the *pébrine*. Lebert had showed that the corpuscles may pass into and affect even the undeveloped eggs of the female moth; and Pasteur proved that the active and ever-increasing propagation and dissemination of the *Pankistophyton* from individual to individual was the cause of the fatal malady. The separation, seclusion, and destruction of the affected worms, the importation of new eggs certified to be free from any taint or disorder, proved the correctness of Pasteur's views, and resulted in the successful arrestment of the epidemic. Large quantities of fresh eggs were imported into France and other countries from Japan, Egypt, and China.

Those moths which produce only one brood of eggs annually bring forth, in Europe at least, the caterpillars which manufacture the best silk. The Bivoltine, or worm with two generations annually, produces inferior silk. In India some forms (for example, *Bombyx sinensis*) produce eggs monthly, whilst three or more generations per annum are by no means uncommon in that country. Of the races or varieties of the familiar *Bombyx mori* the *Novi* race of Italy, with the *Moricand* as its typical example, is a valued variety, which spins a large white cocoon of oval shape. The *Milanais*, another good variety, spins a buff-coloured cocoon of smaller size. The Japanese races produce a cocoon of peculiar shape, having a divided appearance in the centre.

The *Bombyx Yama-mai*, or Japanese Oak-feeding Silk-moth, is a well-known species, producing a green cocoon, the silk of which is much used in Japan for embroidery. The *B. Perni* inhabits North China, and is also an oak-feeder. Its cocoon is large, of grayish-brown colour, and has been used in China, but has not been imported into Europe. The *B. Cynthia*, which feeds on the *Ailanthus glandulosa* of China and North Asia, manufactures a gray cocoon, from which the Chinese manufacture a silk recognized by its soft texture. This species of silk has not been unwound in Europe. The *B. ricini* of Bengal feeds on the castor-oil plant, and is allied to the *B. Cynthia*. The *Antheraea Paphia* of India, or 'Tussur Moth,' as it is called, makes a cocoon of hard consistence and of grayish-white colour. From the silk of this latter form the natives of India manufacture the Tussur silk-fabric. Of the less notable and commercially unimportant Lepidoptera which produce a silky material the North American genera *Polyphemus* of the oak and *Cecropia* of the plum may be mentioned. The genus *Hesperus* of Cayenne; *Faidherbia*, feeding on the *Cytisus*; *Bombyx fauretyi*, from Uruguay, which feeds on a Mimosa; *Pachypusa effusa* of the Cape of Good Hope, *Antheraea Roylei* of the Himalayas; and *Attacus Atlas* of North India—the former feeding on the Evergreen Oak, and the latter on the *Berberis Asiatica*—respectively represent silk-producers varying in importance but as yet unemployed by the commercial cultivator to any extent. *Bombyx textor*, the 'Boro Poloo' of Bengal, makes a pure white silk used by the natives; and *B. fortunatus*, or the Dasee-worm of Bengal, manufactures a yellow silk of inferior quality.

The art of making the filamentous substance of the cocoon available for the use of man seems to have originated with the Chinese, and to have been discovered at a very early period. Until the time of the Emperor Justinian the silk-worm was cultivated only in China, but the raw material was purchased and manufactured by the inhabitants of Per-

sia, Tyre, &c., for a long time before. Aristotle states that Pamphila is reported to have first woven in Cos, and it would appear that the inhabitants of the island of Cos were in the habit of unweaving the heavy fabrics of the East, and of again spinning and weaving them into fabrics of a more variegated texture; and this appears to be the origin of silk-gauze. Before the reign of Augustus the use of silk was little known in Europe. The culture of the silk-worm was down to the sixth century unknown in Europe, but was introduced in rather a singular manner. Two Persian monks had gone as missionaries to the Christian churches at this time established in India; these monks devoted great attention to the culture of the silk-worm, and perceiving that this species of industry would be highly advantageous to other countries, they managed to carry away a quantity of the eggs packed in a hollow cane, which they conveyed to Constantinople. This occurred in the year 552. The monks superintended the hatching of the eggs, and thus originated the raising of silk-worms in Europe. Justinian took the manufacture entirely into his own hands, and all the silk rearers and weavers were compelled to work under the superintendence of his treasurer. He prevented the importation of eastern silk, and by raising the price of the home manufacture led to the cultivation of the silk-worm in the neighbouring countries. Silk was soon manufactured in Greece, and particularly in the Peloponnesus. The merchants of Venice formed the channel through which the silk produce of the Greeks was transferred to the west of Europe. The silk manufacture continued in this state for six centuries; but in 1146 Roger I., king of Sicily, in his conquest of Greece took away many of the people engaged in this species of industry, whom he compelled to prosecute their avocations in his own dominions at Palermo. A knowledge of the management of silk soon spread through Italy, and ultimately reached Spain, from whence it was, in the reign of Francis I., introduced into France.

Bologna was the only Italian city before the commencement of the sixteenth century in which the throwing or twining of silk was performed by machinery. Antwerp was for a long period celebrated for its trade in silken goods, but having been taken by the Duke of Parma in 1585, a check was for a time put upon its commerce, and also that of the Low Countries. Those engaged in the silk and other manufactures in Flanders and Brabant sought and obtained refuge in England. Exactly a century later the revocation of the Edict of Nantes by Louis XIV. drove hosts of industrious silk workers into exile, as many as 50,000 having settled at Spitalfields, London. In 1697 and 1701 acts were passed prohibiting the importation of foreign silk goods, and continued in force until 1826, after having done incalculable mischief to the trade. The duties on the raw material were now greatly lowered, and foreign silks were allowed to be imported at an *ad valorem* duty of 30 per cent. This system was at first bitterly opposed, as being fatal to home manufacture, but the result proved it was based on sound principles. The manufacturers, no longer protected by a monopoly, were compelled to call all the resources of science and ingenuity to their aid in order to compete successfully with their foreign rivals; and the consequence was that the manufacture improved more during the next fifty years than it had done for centuries. In 1846 the duty on foreign silk goods was reduced to 15 per cent *ad valorem*, and the duties on raw and thrown silk were repealed. In 1859 all duties on silk manufactures were taken off. A silk throwing-mill constructed on models secretly obtained from Italy was fitted up at Derby in 1714 by

Thomas Lombe (afterwards Sir Thomas Lombe), a London merchant. He obtained a patent in 1719, and on its expiration he was granted a sum of £14,000. In France silk weaving was first carried on in the county of Venaissin. Looms were set up in Lyons in 1450 and in Tours in 1470. The weavers were generally Italians. Shortly before the revocation of the Edict of Nantes there were from 9000 to 12,000 looms in operation in Lyons alone. About twenty years later the number had fallen to about 5000, and only reached the higher figure half a century afterwards. In 1564 Traucat, a working gardener of Nismes, formed the first nursery of white mulberry-trees for silk-worms. The mulberry plantations were encouraged by Henry IV., and since then they have been a source of beneficial employment to the people of France.

According to recent statistics the annual production of cocoons in Europe is about 124,000,000 lbs., and of silk about 11,000,000 lbs.; and Asiatic Turkey produces in addition about 25,000,000 lbs. of cocoons and 2,000,000 lbs. of silk. The production of Italy is about 91,500,000 lbs. in cocoons, and 7,400,000 lbs. in silk; and of France, 15,400,000 lbs. in cocoons and 1,230,000 lbs. in silk. Next in order come the Caucasus, Austria-Hungary, European Turkey, Spain, and Greece. The amount of silk annually exported from China is about 25,000,000 lbs., and from Persia and Turkestan 500,000 lbs. The annual production of India is about 800,000 lbs. The imports of raw silk into the United Kingdom in 1901 amounted to 1,332,480 lbs., valued at £768,390; of thrown silk, 577,666 lbs., valued at £564,141; of knubs or husks of silk and waste, 48,162 cwts., valued at £403,549; and of manufactured silk goods, £13,030,321.

*Manufacture.*—The first operation in the silk manufacture is the unwinding of the cocoons, the thread being coiled upon a reel. The reeling of silk, as practised in Piedmont, where silks of the best description are manufactured, is performed in the following manner:—The cocoons are placed in an oblong copper vessel,  $1\frac{1}{2}$  foot in length and 6 inches deep; the vessel is supported upon a brick stove, and the water in it heated by charcoal. The vessel is divided into transverse portions, into each of which, generally, five cocoons are placed. The ends of the filaments are led from the cocoons in the vessel, and guided by passing on hooked wires, so as to be separated from each other, and also made to cross, so that by rubbing on one another they may be cleaned. The threads then pass through a guide, which moves alternating transversely, from which they pass upon the revolving reel. The reel consists of four arms, which support rails parallel to the axis, and these rails are placed at such a distance from each other that one turn of the reel winds off 1 yard in length of the filament. One of the arms of the reel is furnished with a joint, so that it may, as occasion requires, fold down, and by slackening the coil allow it to be slipped easily off the reel. Motion is given to the machine by a crank on the axis of the reel, or by a revolving pulley connected to it and the traverse by bands and wheel-work. The water in the copper is kept nearly at the boiling point, to soften the gummy matter of the cocoons. Four or more threads, being led from the copper together and uniting by the gum, form one thread. When any one of the filaments breaks, a union must be made by laying on another, the gum being sufficient to cause the adhesion without tying. Great care is required in reeling, however simple the process may appear. The filament grows smaller as the cocoon is unwound, so much so that when a cocoon is half unwound the filament is only half the thickness of what it was at the beginning. A woman,

with the assistance of a girl, can, on an average, wind off 1 lb. of silk per day, when the silk is of the finest description; but if of the coarsest, six or eight times that quantity. The cocoons which have been pierced by the worm are treated in a different manner. After being boiled and placed in a basin they are wound upon a distaff; the silk thus obtained is called *jeuret*, and from its superior quality sells at a much higher price than that procured by the former process. By the latter method a good spinner will not produce more than 1 oz. of thread in a day. The factory in which the reeling is carried on is called a *filature*, and the silk thread produced in the manner we have described is called *raw silk*.

Raw silk is not adapted for the fabrication of cloth; and it must undergo the operation of *throwing*. In Britain this is a special trade, the silk-thrower usually conducting it in large mills with extensive machinery generally driven by steam-power. The silk which is imported in hanks is first carefully washed in soap and water, and is then dried in a room constructed for this purpose. The hanks are now stretched on large skeleton six-sided reels called *swifts*, so adjusted that they will hold the hanks tightly. As the swifts revolve the silk is carried from the hanks to bobbins, upon which it is wound for convenience in the succeeding operations. The bobbins are then taken to the cleaning machine, and placed upon fixed spindles, on which they revolve with the slightest pull; the thread is passed through an adjustable opening between two upright iron blades of the cleaner, which forms the gauge of the thread, and which removes any irregularities or adherent dirt. The thread is next passed over a metal or glass rod, and then through another hole (larger than that of the cleaner, and usually made of glass), on to the empty bobbins, upon which it is wound by the action of the machine.

This being done, and the silk assorted as to its fineness, it is carried to the throwing-mill. This machine will be easily understood by a reference to our description of the bobbin-and-fly frame, under the article COTTON-SPINNING. But in the throwing-mill the process is somewhat different from that in the cotton-spinning machine. On consulting the article above referred to, it will be seen that the thread or rove (according as the apparatus we are speaking of is used as a fly-frame or throstle) is wound upon the bobbin; but in the silk-throwing machine the process is reversed, the thread being unwound from the bobbin, twisted by the revolution of the flyer, and wound upon a reel. In the passage of the silk threads from the bobbins to the reel there is no drawing, or in other words there are no rollers between which the threads pass, so as to be drawn out, as in the water frame of Sir Richard Arkwright. The silk is only twisted. The twist of the silk thread may be altered, according to circumstances, by varying the relative velocities of the reel and flyer. The silk intended for organzine receives the greatest number of twists in the inch. The silk thus prepared is called *singles*, and is used for weaving common broad stuffs or plain silks and ribbons.

The next operation, called *doubling*, is to bring two or more of these threads twisted upon one bobbin. This is done in a throwing machine, like that we have spoken of above, and the silk thus spun is called *tram silk*, commonly used for the woft of the richer silks and velvets. In its formation the twists have been given all in one direction, and it is accordingly of the nature of twine, or the strands of which a rope is composed. Two or more of these threads of tram silk twisted in the throwing mill together constitutes organzine, a species of silk thread em-

ployed for warps of fine fabrics. There is, however, this distinction between organzine and tram silk, that whereas the threads of the latter are all twisted in one direction, forming individual strands, like twine, the threads of the former are twisted in an opposite direction, like rope, that is, if in a thread of organzine each strand be twisted to the right, then the collected threads are spun or twisted to the left, as in the formation of a rope or cable.

In the state to which we have now brought the silk it is said to be *hard*, in consequence of the gum, which, however, is separated by boiling. The boiling process requires great care, and in consequence of ignorance or negligence often destroys the silk. It is much more safe to separate the gum by steam. The hanks of raw silk are not boiled but soaked in a tub of tepid soap water.

The throwing-machine has been greatly improved both as to accuracy and produce by assimilating it to the cotton throstle. The speed of the spindles of the machines in Great Britain as well as on the Continent was at a low rate, not exceeding 1200 revolutions in the minute; but now, from the exertions of Messrs. Fairbairn, Lillie, Ritson, and others, the speed has been raised to 4500. Another very ingenious process in the manufacture of silk thread has been made the subject of letters patent and brought into successful operation. The use of this process or combination of processes is to spin into thread the waste of the throwing-mill. This waste is made to pass through an endless heckle of a construction that will be understood from what follows. The ends of the silk waste are placed between the edges of two boards, which are then firmly screwed together so that the silk hangs out like a fleece; a great many of these pairs of boards are placed firmly in an oblong frame. Over this frame there is an endless web moving, which passes round rollers at each end. This web carries upon it a series of heckles, all moving with it. When these heckles pass along the under side their teeth act upon the silk in the frame below and clear it. When the heckling is finished in a coarse machine the boards with the silk are placed in a finer heckle frame, and the process is thus continued as far as is found necessary. The silk thus heckled is now carried to a cutting machine, where it is laid regularly upon an endless web moving at a certain rate along the side of the cutting machine. At the end there are a series of revolving knives, which cut the silken fibres into lengths of 1 inch or more. In this state it is opened up by being passed through a blowing engine similar to that described in our article COTTON-SPINNING. After being blown it is boiled in a lea of soap water for several hours in order to free it of the gum. After drying it passes through the processes of carding, drawing, and roving, which are performed by machinery somewhat similar to that used for cotton. The preparation being made the spinning is effected by the organ jenny, or rather mule, a minute account of which has been already given under the article COTTON. The *singles* are thus prepared. The doubling is effected by the common throstle. By means of additional improvements in the spinning of waste silk the operations of cutting, carding, and scutching have been superseded.

In the United Kingdom in 1890 there were 623 silk factories; connected therewith were 1,029,353 spindles and 11,464 power-looms. The number of persons employed in silk factories in the United Kingdom in 1898 was 35,461, of whom 25,187 were females. The manufactures are chiefly located in Spitalfields, London; at Coventry, Manchester, Bradford, Macclesfield, Congleton, and near Glasgow. The silk manufacture of the United States employed 51,000 persons in 1890.

**SILK-COTTON TREE** (*Bombax coëba*), a tree belonging to the natural order Sterculiaceae, indigenous to the West Indies and South America. Its stem is of a reddish colour, and hairy or prickly. The leaves are palmate, divided into five lobes; the flowers are first white, then change to rose colour, and finally become red. The wood is soft and spongy, and not much valued except for the construction of canoes. The trunk is very large, and when scooped out makes canoes capable of containing from 15 to 20 hogsheads of sugar from 6 to 12 cwts. each. When sawn into boards and well saturated with lime water this wood bears exposure to the weather for many years. The down which is contained in the seed capsule is too short, too smooth, and too elastic to be profitably spun by the silk or cotton machines at present in use, and it is accordingly employed in stuffing pillows, chairs, sofas, &c.

**SILLIMAN, BENJAMIN, M.D., LL.D.**, an American physicist, was born in North Stratford (now Trumbull), Connecticut, United States, 8th August, 1779; was educated at Yale College, and graduated in 1796. He studied law, and was admitted to the bar of Newhaven in 1802, but on being offered the professorship of chemistry in his Alma Mater he consented to give up the legal profession, but accepted the offer only on condition that he should be allowed time and opportunity to prepare for the duties connected with the chair. Part of the following two years he spent at Philadelphia as a student of Dr. Woodhouse, and in the spring of 1805 sailed for Europe to prosecute still further his studies in physical science and to procure books and apparatus for the college for the illustration of chemistry and physics. (Of this tour, which lasted fourteen months, and during which he formed the acquaintance of many of the greatest scientific men in England, he published an account, which, as being one of the first works containing in detail the opinions of an educated American on this country, was well received on both sides of the Atlantic. Shortly after his return he made a geological survey of a part of Connecticut, one of the first explorations of the kind made in the United States. He afterwards assisted Dr. Hare in his experiments with the compound blow-pipe, effecting the fusion of several bodies which had been hitherto regarded as infusible, particularly lime, magnesia, and some of the other earths, with metallic bases. In 1818 he founded the American Journal of Science and Arts, better known as Silliman's Journal, of which he was for twenty years the sole, and for eight more the senior, editor. In 1822 he first established the fact of the transfer of particles of carbon from the positive to the negative electrode of the voltaic apparatus. In 1830 he published a text-book on chemistry, and soon afterwards edited an edition of Bakewell's Geology. He published a narrative of his second visit to Europe in 1851, which reached six editions. In 1855 he gave his last course of lectures, when he was succeeded by his son, Benjamin Silliman, junr., who had for some time acted as his assistant. He died 24th November, 1864. A life of the veteran chemist, chiefly from his manuscript reminiscences, diaries, and correspondence, was published by G. P. Fisher in two vols. (London, 1866).

**SILLOTH**, a rising seaport and watering-place of England, in the county of Cumberland, on the coast of the Solway Firth, 18 miles west of Carlisle. The bay is remarkable for its depth and the comparative calmness of its waters, having the advantage of a natural breakwater to the westward in Silloth Bank. The climate is mild, equable, and moderately dry, and the prevalent winds are west and south-west, so that the place is well suited for those suffering from chest complaints, asthma, or rheumatism. A new

dock has been erected which greatly facilitates the trade, which is chiefly with Ireland and the Isle of Man. Pop. about 2500.

**SILURIAN SYSTEM.** See GEOLOGY.

**SILVAS**, or **SILVAS** (Spanish, *selva*, a forest), the name applied to the western part of the extensive plain of the Amazon in the north-west of Brazil. They form about a third of the whole plain, having an area of over 700,000 English square miles, and consist of low land on a dead level, thickly covered with primeval forests, and annually overflowed by the Amazon or some of its tributaries. The vegetation of this region, under the action of the abundant irrigation, the tropical heat, and the richness of the alluvial soil, exhibits an exuberance of growth unequalled in any part of the world. The forests are impassable from the denseness of the underwood, matted together by climbing and creeping plants. They furnish shelter to countless wild animals, especially monkeys and serpents. The aboriginal inhabitants thinly scattered over this territory are plunged in the lowest state of ignorance and barbarism.

**SILVER.** Silver is one of the best known of the metals, and has been in use from a very remote period, indeed probably long before the commencement of history. It is widely distributed, it occurs native or in minerals which can be very easily reduced, and its colour and other properties are sufficiently striking to attract attention.

*Physical Properties.*—Silver is the whitest of the metals, indeed its colour can only be described as silver-white, and from this property it takes its Greek name *argyros*, from roots seen in *argos*, white, and thence the Latin name *argentum*, from which comes the chemical symbol, Ag. It has a brilliant lustre and takes a fine polish. It is somewhat harder than gold and softer than copper. It is very malleable and ductile, being second only to gold in these properties. Silver foil is largely made, and sheets not more than  $\frac{1}{100}$  of an inch thick have been rolled. Its tenacity is said to be about 17 tons per square inch, but this property is of very little importance, as the metal is never used for structural purposes. The specific gravity of rolled silver is about 10.488, castings being somewhat lighter. Silver melts at about 945° C. (1733° F.), a bright red-heat. It is not volatile at temperatures not much above its melting-point, but can be distilled in the heat of the electric arc or of the oxyhydrogen flame. The boiling-point is not known definitely, but it is probably over 2000° C. (3600° F.). When silver is heated with lead or other volatile metals there is always considerable loss. Silver is a good conductor of heat and electricity, standing at the head of the list of metals as regards both these properties. When the metal is melted in presence of air it absorbs a considerable quantity of oxygen—under favourable conditions as much as 22 times its own volume. This is given out as the metal solidifies. As a mass of cooling metal solidifies first at the outside, the gas evolved during the solidification of the interior exerts great pressure, often forming cracks through which the still liquid metal is forced, thus producing what is known as vegetation or sprouting, which is seen when molten silver solidifies. This is to some extent a test of the purity of the metal, since small quantities of foreign metals completely prevent it. Owing to this absorption of oxygen it is not possible to cast pure silver unless it has been melted out of contact with the air.

*Chemical Properties.*—Symbol, Ag; atomic weight, 108 (107.66). Silver does not oxidize when heated to redness in air, hence it is classed with the noble metals; nor does it oxidize on exposure to air and

moisture. It is readily attacked by many sulphur compounds with the formation of black silver sulphide, so that it tarnishes rapidly in the air of towns. It is dissolved by nitric and by strong sulphuric acids, but dilute sulphuric and hydrochloric acids have little action on it. Chlorine, bromine, or iodine attack it readily.

**Silver Oxide.**—One oxide is known,  $\text{Ag}_2\text{O}$ . It is an unstable body of little importance.

**Silver Chloride,  $\text{AgCl}$ .**—This salt is insoluble in acids, and is readily prepared as a curdy white precipitate by adding a soluble chloride to an acid solution of a silver salt. It is insoluble in water or acids, but dissolves readily in ammonia, to some extent in solution of common salt and many other chlorides, and readily in potassium cyanide and sodium thiosulphate (hyposulphite). It melts at about  $360^\circ\text{C}$ . to a clear liquid, which solidifies on cooling to a horn-like mass. It is rapidly darkened on exposure to light, and it is used as the basis of many photographic printing papers. It is readily reduced by fusion with sodium carbonate, by the action of zinc and hydrochloric acid, or by fusion with other metals such as lead.

**Silver Bromide and Silver Iodide,  $\text{AgBr}$  and  $\text{AgI}$ ,** are very similar to the chloride in all their properties. They are less acted on by light, but even exposure to a very feeble light produces a superficial change, whether molecular or chemical is not certainly known, so that a weak reducing agent which would have no action on the salts that had not been exposed to the light causes a separation of silver. Advantage is taken of this in the preparation of photographic plates, which are coated with one or both of these salts suspended in a suitable vehicle.

**Silver Nitrate,  $\text{AgNO}_3$ .**—This is a white crystalline salt, readily soluble in water. It is a powerful corrosive, and when fused and cast into sticks is known as lunar caustic. In presence of organic matter it blackens rapidly on exposure to light. It is decomposed by heat, and is prepared by dissolving silver in nitric acid.

**Silver Sulphate,  $\text{Ag}_2\text{SO}_4$ ,** is a slightly yellow crystalline salt, readily soluble in hot, but sparingly soluble in cold, water. It melts at a dull red-heat without decomposition, but breaks up at a higher temperature. It is prepared by dissolving silver in hot strong sulphuric acid.

**Silver Sulphide,  $\text{Ag}_2\text{S}$ ,** is a black substance readily formed by the action of hydrogen sulphide on a solution of a silver salt, or even on metallic silver; it is also formed when silver and sulphur are heated together. The black tarnish which forms on silver articles when exposed to the air of towns is due to the formation of this substance.

There are other salts of silver, but they are of little importance.

**SILVER MINERALS.**—A large number of minerals containing silver occur in nature.

**Native Silver** frequently occurs in small irregular pieces or in thread-like or branching masses with various silver ores, and with native copper. It is often very pure, but is rarely abundant enough to be treated by itself. When fresh it is silver-white and metallic, but is often tarnished.

**Horn Silver (Kerargyrite)** is the chloride. It is an abundant silver mineral, occurring in horn-like masses of a grayish colour, rapidly turning black on exposure to light. It is easily cut and is very soft. **Embolite,  $\text{Ag}(\text{ClBr})$ ,** a chlorobromide, **Bromyrite,** the bromide, and **Iodyrite,** the iodide of silver, also occur, and closely resemble horn silver in their properties.

**Argentite (Silver-glance),  $\text{Ag}_2\text{S}$ ,** is an important

mineral, containing when pure 87.1 per cent of silver. It is black, has a metallic lustre, and can be cut easily. Silver sulphide shows a great tendency to combine with the sulphides of arsenic and antimony to form double sulphides or sulpho-salts. Of these several occur in nature, such as

**Pyrargyrite** (dark-red silver ore),  $3\text{Ag}_2\text{S}, \text{Sb}_2\text{S}_3$ ; **Proustite** (light-red silver ore),  $3\text{Ag}_2\text{S}, \text{As}_2\text{S}_3$ ; **Stéphanite,  $5\text{Ag}_2\text{S}, \text{Sb}_2\text{S}_3$** ; and **Polybasite**, which contains sulphides of silver, copper, arsenic, and antimony in varying proportions. A considerable number of similar minerals is known, but they are of little importance.

**SILVER ORES.**—The ores of silver consist of one or more of these minerals associated with more or less earthy or rocky matter. Silver is so valuable that a small percentage will allow an ore to be worked, so that it often happens that in the ores the minerals are present in such small quantity that their properties cannot be observed.

Ores may be classified into three groups:—

(1) **Free-milling Ores**, in which the silver is present in such a form that it can be extracted by the action of solvents. The silver is present in them either in the native condition, or as chloride, bromide, or iodide.

(2) **Refractory Ores**, in which the silver can be converted into a soluble form by some preliminary treatment, such as roasting with salt. The silver in these ores is usually present as sulphide, with or without the sulphides of arsenic and antimony.

(3) **Smelting Ores**, in which the silver, usually as sulphide, is associated with the sulphides of other metals, such as lead and copper, so that when the ore is smelted the silver is carried down by the base metal from which it must be separated.

**Distribution of Silver Ores.**—Silver ores are widely distributed. There are none in Great Britain, if we exclude the lead ores, which carry a small quantity of silver. The quantity obtained, however, is very small—the value amounting only to some £20,000 per annum. In Europe the best-known localities are Saxony and Bohemia, and the Hartz mountains. America is very rich in silver ores, and the United States and Mexico are the two chief silver-producing countries in the world at the present day. Nevada has yielded enormous quantities from the Comstock, Eureka (silver-lead), and other lodes. Utah, Colorado, and other states have also yielded large quantities. The total production of the United States for 1901 was estimated to have a value of £7,457,000, Colorado among individual states standing at the head, and being followed by Montana and Texas, with smaller quantities from other states. Among the great silver-producing districts of the world have been Mexico, Peru, and Bolivia, the first mentioned in particular being very rich in the metal. The Mexican mines, according to an approximate estimate, have yielded silver to the value of between £800,000,000 and £700,000,000. Individual mines are very numerous in Mexico, and the aggregate annual output seems to have a value about equal to that of the United States. Bolivia produces silver to the value of over a million annually. In Australia the Broken-hill mines in New South Wales have been among the richest known.

**EXTRACTION OF SILVER FROM ITS ORES.**—Three general methods are in use for treating silver ores—

(1) **Amalgamation**, in which the metal is dissolved in mercury.

(2) **Leaching processes**, in which the silver is dissolved in some suitable solvent, preliminary treatment being usually necessary to convert it into a soluble form.

(3) Smelting processes, in which the ore is smelted for a base metal from which the silver is afterwards separated.

**AMALGAMATION.**—Since most silver ores are not acted on by mercury this method is of only limited application directly; but some ores, though not acted on by mercury, can be converted into forms on which mercury can act. In the early days of the South American silver industry the metal was nearly always obtained by mercury, after such a preliminary treatment. The processes were carried out differently in different districts, but the Mexican or *patio* process, which is best known, may be taken as a type.

**The Mexican Process.**—The ores, which consist mainly of sulphide or double sulphides, are picked over by hand, portions which are too rich for treatment being put aside for export. The ore to be treated is crushed to a coarse powder under stamps, or in a mill, and is then transferred to the *arrastra* for fine grinding. The *arrastra* is a circular paved space, into which the ore moistened with water is introduced and is ground under heavy stones, which are drawn round by mules. If gold be present, mercury is added to dissolve it. The wet ore is then spread in large heaps on the patio or amalgamating floor, and is allowed to dry till it is of the proper consistency; from 3 to 5 per cent of salt is then added, and the whole is thoroughly mixed, by mules treading it and workmen turning it with spades. The mass is allowed to rest for a day or so, and then *magistral*, a mixture containing sulphate of copper prepared by roasting copper pyrites is added, mercury is scattered over the heap, and the mass is well trodden by mules. The treading is repeated daily for some time, more mercury being added as required, especially towards the end, to collect the amalgam. A complicated series of reactions takes place, as a result of which the silver minerals are decomposed, and the silver is dissolved by the mercury. The material is then washed, so as to remove the earthy matter and leave the heavy amalgam. This is squeezed through leather or canvas, and the pasty amalgam is distilled for the recovery of the silver.

**Washoe Process.**—Of the modern amalgamation processes the best-known is the Washoe, used on the Comstock lode for treating complex silver ores. The ore is broken up in a stone-breaker, and is then crushed to powder in a stamp battery, very similar to that used in gold-milling, the screen having 30 or 40 meshes to the inch run. The pulp flows to settling tanks, where it is allowed to settle, and is then transferred to pans for amalgamation. An amalgamating pan is a circular vessel 4 to 6 feet in diameter, the bottom of which is protected by a false bottom of cast-iron called the *die*. On this is rotated a circular plate of iron, the *muller*, provided with cast-iron shoes, so that the ore is ground between the die and the shoes. The charge of from 1 to 3 tons of material is introduced, with the necessary amount of mercury, salt, and sulphate of copper, other chemicals being sometimes added. The pan is heated either by a steam-jacket or by blowing in steam. The grinding is continued for from three to five hours, till the material is reduced to an impalpable powder. It is then washed into settlers. The lighter earthy matter is washed away, and the amalgam is collected, squeezed through canvas, and the residue is distilled for the recovery of the silver.

Amalgamation processes are not very satisfactory for the treatment of silver ores; the extraction of silver is often poor, and the loss of mercury is considerable. They are therefore being generally abandoned in favour of the leaching methods.

**LEACHING METHODS.**—In these methods the silver is converted into a soluble form, usually the chloride, and this is then extracted by suitable solvents. The chloridizing is usually effected by roasting the powdered ore with salt, in a reverberatory or other furnace. The solvent used varies with the process; in the Augustin process it is a strong solution of salt, and in the Von Patara and Russell processes a solution of sodium thiosulphate (hyposulphite).

**Augustin Process.**—The ore is roasted with salt till it is completely chloridized, and it is then treated with a strong solution of common salt, in which the silver chloride is soluble, and the silver is precipitated from the solution by means of scrap copper.

**The Claudet Process.**—This is used for the treatment of poor copper ores carrying silver. The ore is roasted with salt, and is then treated with hot acidified water. There is enough salt present to form a brine which will dissolve the silver chloride, and the copper dissolves as chloride. To the solution zinc iodide is added exactly in the right proportion, and the silver is precipitated as silver iodide ( $\text{AgI}$ ), which is insoluble in brine. The silver iodide is collected and treated with zinc, by which metallic silver is separated, and zinc iodide is formed and can be used again for precipitating silver. The crude silver mud is subsequently refined by cupellation with lead.

**The Von Patara Process.**—In the Von Patara process the ore is roasted with salt to convert the silver into chloride, but only a small excess of salt is used. The chloridized ore is washed with water to dissolve out any base metals, such as copper or zinc, which will have been converted into soluble chlorides or sulphates, and also any acid formed during roasting, which, if left, would decompose the sodium thiosulphate. Any silver dissolved by the salt is thrown down by scrap copper. The washed ore is then leached with a solution containing about 2 per cent of sodium thiosulphate which dissolves the silver, and from the solution the silver is precipitated by calcium or sodium sulphide as silver sulphide ( $\text{Ag}_2\text{S}$ ), which, on being strongly heated in air, is converted into metallic silver.

**The Russell Process.**—This is a modern modification of the Von Patara process, and is now largely used. The ore is treated exactly as described, and, if lead be present, this is precipitated from the thiosulphate solution as carbonate by the addition of sodium carbonate. The residue, after treatment by sodium thiosulphate, is treated with what is known as extra-solution, which is a solution of cuprous-sodium thiosulphate. This dissolves the silver left undissolved by the thiosulphate, and thus considerably increases the yield. The silver from this solution is thrown down by sodium sulphide, the precipitate is treated with nitric or sulphuric acid, and the silver is precipitated by metallic copper.

For most leaching processes it is essential that the chloridizing should be complete; that is, that all the silver should be converted into chloride. In the Russell process this is much less important, as the unaltered sulphides are dissolved by the extra-solution, and in some cases of chloridizing washing may be dispensed with. Small quantities of gold, if present, are also dissolved by the extra-solution, and may be recovered. On the other hand, silver chloride is less soluble in the extra-solution than in simple hyposulphate, and therefore in most cases both solutions must be used. This process is rapidly superseding all others for the treatment of silver ores for which smelting methods are not suitable.

**The Ziervogel Process.**—This method is only applicable to the treatment of rich copper regulus con-

taining silver. The material is finely ground, and is roasted at such a temperature that sulphates of iron, copper, and silver are formed, and then the two first are decomposed. The roasted mass is treated with hot water, which dissolves the silver sulphate, and from the solution the silver is precipitated by copper.

**SMELTING METHODS.**—The ores which are usually smelted are those which contain lead or copper. The lead ores are smelted in the usual way (see LEAD), the silver going into the lead. This is concentrated by either the Pattinson or the zinc process (see LEAD), and the resulting silver lead is cupelled. In the case of copper ores the silver goes with the copper, and may be separated in several ways. The rich regulus containing the copper and silver may be treated by the Zierovogel process, or the copper may be reduced and the silver may be separated by electrolytic refining.

**Cupellation.**—In almost all cases the silver is finally purified by fusion with lead and cupellation. When silver-lead is heated with free access of air, the lead is oxidized and the silver is left, and if the oxidation be carried on on a hearth of bone-ash, which has the property of absorbing melted litharge, the last traces may be removed.

The system of cupellation usually used is that known as the English process. The furnace used is a small reverberatory furnace, the hearth of which is made movable, and consists of an iron frame into which moistened bone-ash is rammed, and in this a cavity to contain the lead is cut out. The lead to be cupelled is melted, and a blast of air is blown over the surface from a jet; the air oxidizes the litharge, and this runs over the end of the hearth or cupel. Lead is added from time to time so as to keep up the level of the bath, till about 5000 to 7000 ounces of silver is on the hearth; then the oxidation is continued till all the lead is oxidized and the bath of silver is clear and brilliant. This is then allowed to cool. As it solidifies, the surface is thrown up into irregular elevations by the escape of oxygen, and unless care be taken silver may be lost by scattering. The cupel is then removed from the furnace, the bone-ash broken away, and the silver is ready for the market. If the silver lead be rich, say 5000 ounces to the ton, the process is conducted as above; if it be poorer, the cupellation is carried on till about that richness is reached, when the lead is tapped out and the process started again, this being continued till enough rich lead has accumulated to yield the required amount of silver. This is then cupelled till all the lead is removed. In the German system the process is commenced in a furnace with a hearth of clay, and is finished on bone-ash. Any gold present in the ore will remain with the silver.

**ELECTRO-DEPOSITION OF SILVER.**—Electro-plating is very largely carried on, articles of various kinds being thus coated with silver. The process is very simple since silver is very easily deposited from its solutions. The solution used is almost always a solution of silver-cyanide in potassium cyanide, and the silver is precipitated by a very feeble current; indeed silver-plating may be done by simple immersion in certain solutions of silver salts without the use of a battery at all. The solution being prepared of suitable strength, the article, which has been thoroughly cleaned by washing, dipping in acid and alkali, and scratch-brushing, is attached to the wire from the negative pole of the battery, and is put into the solution so as to form the cathode, the anode being a plate of silver. The silver is rapidly precipitated, and comes down as a firmly adherent film, which is silver-white, but rough or matt, i.e. not bright. As the article is usually required bright,

when enough silver has been deposited the article is removed from the bath, rinsed, and polished by means of brushes or burnishers. Silver may be thrown down bright so as not to need burnishing by adding bisulphide of carbon—or some other suitable substance—to the bath. The deposition is slow, and the brightening bath is usually only used to give a finishing layer to the article. Electro-types of silver are made by depositing a thick layer of silver on a suitable mould, and then removing the mould, and by using a mould in many portions very elaborate electrotypes can be prepared. (See ELECTRO-METALLURGY.)

**USES OF SILVER.**—Silver is mainly used for coinage and for ornamental purposes.

For coinage the silver is always alloyed with a certain amount of copper. The British coinage contains 92·5 per cent of silver, whilst that of many other countries only contains 90 per cent. The quantity of copper present in such rich alloys does not much impair the silver-white colour of the metal.

For ornamental purposes the alloy used is usually of the same composition as the coins, and is then called standard silver. Such articles may be assayed and stamped with the hall-mark.

**Oxidized Silver.**—Ornamental silver articles very frequently have the surface—as it is very improperly called—oxidized. This is done either by rubbing the article with a solution of platinum-chloride, which is decomposed, a layer of platinum being deposited; or with a solution of sodium-sulphide, in which case a layer of sulphide is formed on the surface.

Owing to the readiness with which silver is attacked and blackened by sulphur compounds, it is not well suited for ornamental purposes.

**Photography.**—Owing to the readiness with which silver salts are acted on by light, they are largely used for photographic purposes. The ordinary silver printing papers consist of silver chloride, carried in a layer of albumen gelatin or collodion, the active agent in most cases being not the chloride but organic salts of silver formed by union of the silver with the organic vehicle. The ordinary photographic dry plates consist of very finely-divided silver bromide or iodide, carried in a layer of gelatin, or more rarely of collodion. The light acting on the silver compound produces some change, by virtue of which it becomes much more readily reduced by reducing agents—the developers—to metallic silver, the image being fixed by the solution of the unaltered salt in some solvent—usually sodium thiosulphate (hypo-sulphite). The image in the case of a negative is therefore made up of finely-divided metallic silver suspended in gelatin, and is much more permanent than the ordinary print, in which the image is composed of silver salts of uncertain composition, and often not of very great stability. In bromide prints the image is composed of silver, as it is in the negative. (See PHOTOGRAPHY.)

The price of silver has fallen very much during the last few years, owing mainly to the largely increased output due to the discovery of the very rich deposits in Australia and the United States. See also COINING, CURRENCY, BIMETALLISM, MONETARY SYSTEMS, &c.

**SILVERING.** The application of silver leaf is made in the same way as that of gold, for which see GILDING. Copper may be silvered over by rubbing it with the following powder:—2 drachms of cream of tartar, the same quantity of common salt, and  $\frac{1}{2}$  drachm of alum are mixed with 15 or 20 grains of silver, precipitated from nitric acid by copper. The surface of the copper becomes white when rubbed

with this powder, which may afterwards be brushed off and polished with leather. A cheap silvering is prepared as follows:— $\frac{1}{2}$  oz. of silver that has been precipitated from a nitric acid solution by the addition of copper, common salt, and chloride of ammonium, of each 2 oz., and 1 drachm of perchloride of mercury, are triturated together, and made into a paste with water; with this copper utensils of every kind, that have been previously boiled with tartar and alum, are rubbed, after which they are made red-hot, and then polished. The intention of this process appears to be little more than to apply the silver in a state of minute division to the clean surface of the copper, and afterwards to fix it there by fusion; and accordingly this silvering may be effected by using the argentine precipitate here mentioned with borax or mercury, and causing it to adhere by fusion. The dial-plates of clocks, the scales of barometers, and other similar articles, are silvered by rubbing upon them a mixture of chloride of silver, sea-salt, and tartar, and afterwards carefully washing off the saline matter with water. In this operation the silver is reduced and precipitated in a finely-divided state on the metallic surface. It is not durable, but may be improved by heating the article, and repeating the operation till the covering seems sufficiently thick. The silvering of pins is effected by boiling them with tin filings and tartar. Holton mirrors or globes are silvered by an amalgam consisting of one part by weight of bismuth, half a part of lead, the same quantity of pure tin, and two parts of mercury. The solid metals are to be first mixed together by fusion, and the mercury added when the mixture is almost cold. A very gentle heat is sufficient to fuse this amalgam. In this state it is poured into a clean glass globe intended to be silvered by means of a paper funnel, which reaches to the bottom. At a certain temperature it will stick to the glass, which by a proper motion may thus be silvered completely, and the superfluous amalgam poured out. The appearance of these toys is varied by using glass of different colours, such as yellow, blue, or green. For a description of the silvering of mirrors see the article MIRROR. Most of the silvering processes formerly in use are now, however, superseded by the electro-process. See ELECTRO-METALLURGY.

**SIMARUBACEÆ**, a natural order of exogenous plants. Flowers hermaphrodite; sepals four or five, with the same number of petals; and twice as many stamens; leaves without stipules, alternate or opposite; flowers white, greenish, or purplish. This order, which is not numerous, consists of trees and shrubs, all having an intensely bitter bark, a milky juice, and pinnate leaves. They are found in the region of the tropics. The *Simaruba officinalis* or *Simaruba* bark is one of the most powerful bitters known; and the wood, bark, and root of the *Quassia*, another species of this order, occupies an important place in the  *MATERIA MEDICA*.

**SIMBIRSK**, a government of Russia, bounded north by Kasan, east by Orenburg, south by Saratov, and west by Penza and Nijnei-Novgorod; greatest length, north-west to south-east, 260 miles; greatest breadth, 140 miles; area, 19,110 square miles. It consists in general of an extensive plain of great fertility, and watered by the Volga, which traverses it circuitously from north to south. The climate is considered mild, though the Volga annually freezes for five months. The principal crops are grain, hemp, flax, hay, and tobacco. The minerals do not include metals of any consequence. Fish abound both in the rivers and in the lakes, which, though individually of small dimensions, are very numerous. Pop. (1897), 1,549,461.

**SIMBIRSK**, a town of Russia, capital of the government of the same name, on a lofty bank of the Volga, 448 miles N.E. of Moscow. It is a well-built place, almost the whole of it being more recent than 1864, when it was almost destroyed by a great fire. It has an extensive trade in grain. Pop. (1897), 43,298.

**SIMEON STYLITES**. See **STYLITES**.

**SIMFEROPOL**, a town of Russia, capital of the government of Taurida, on an elevated plain at the foot of lofty hills, 40 miles north-east of Sevastopol. It consists of an old and a new town—the former poorly built, and occupied chiefly by Tartars, the latter with a handsome square and regular, spacious streets, and has several churches and mosques, a gymnasium, and a large civil and military hospital. Pop. (1897), 48,821.

**SIMLAH**, a town of India, in the Punjab, chief sanitarium and summer capital of British India, 78 miles N.N.E. of Umballa. It stands 7000 feet above the sea, and consists of isolated houses, perched along the heights among oak and deodar forests, including many fine public buildings. The viceroy and chief officials remove here from Calcutta in the hottest season. Its average temperature is about 62°, and its summer heat seldom exceeds 72°. The stationary population is about 14,000.

**SIMODA**, a seaport town of Japan, near the south-eastern extremity of Idzu, on the Island of Nippon, and at the western entrance of the Gulf of Yeddo. It was nearly destroyed by an earthquake on December 23, 1854, which caused the sea to rush in with such violence as to sweep almost everything before it. It has, however, been in great part rebuilt, and since 1857, when the Dutch treaty was signed, it has been a free port for foreign commerce.

**SIMOIS**, a river of Troas, which rises in Mount Ida and falls into the Xanthus. It is celebrated by Homer and most of the ancient poets, as many battles were fought in its neighbourhood during the Trojan war. Its modern name is Dumbrek Chai, and its course is so altered as to lead directly into the Hellespont, being no longer, as formerly, a tributary of the Scamander.

**SIMONIDES**, a celebrated Greek lyric poet, son of Leoptepes, was born in the Island of Ceos B.C. 556, and appears to have been devoted from his earliest years to music and poetry. Invited by Hipparchus, who then ruled over Athens, to visit that city, he proceeded thither, and among other distinguished men whom that ruler had gathered around him, he there met Anacreon and Lasus, Pindar's master. After the death of Hipparchus, from whom he had received very generous treatment, he seems to have proceeded next to Thessaly, where he obtained the patronage of the Aleuads and Scopads, whose victories in the sacred games he celebrated in immortal verse. He subsequently returned to Athens, and at a competition for the best elegy upon those who fell on the field of Marathon, gained the prize over Æschylus himself. When eighty years of age he was victorious in another celebrated poetical contest, which was his fifty-sixth victory of this nature. Shortly after this he was invited to the court of Hiero at Syracuse, where he remained till his death in 467 B.C. at the advanced age of ninety. He appears to have been a chief favourite with Hiero, though at that time his court was adorned by the presence, among others, of Pindar, Bacchylides, and Æschylus. Elaborate finish, true poetic conception, genuine pathos, and perfect power of expression, in addition to the sweetness which procured for him the surname of *Meliœetes*, are among the chief characteristics of his versification, though in originality he was surpassed by his contemporary Pindar.

He brought the elegy and epigram to a high degree of perfection, and in the dithyramb and triumphal ode he particularly distinguished himself. To Simonides is attributed also the invention of the art of artificial memory, and he is credited with the addition to the Greek alphabet of the long vowels and the double letters. He made literature a profession, and appears to have acquired the unenviable fame of being the first who took money for his poems. Only fragments of the works of this poet have come down to us. The best editions of these are Schneidewin's (*Simonidis Cei Carminum Reliquiae*; Brunswick, 1835), and Bergk's (in his *Poetæ Lyrici Græci*).

SIMON MAGUS, or the *Magician*, an impostor mentioned in the Acts of the Apostles, a native of Samaria, who pretended to be an *exorcist* of an exalted nature, and called himself the supreme power of God. (See *Gnostics*.) Struck with astonishment at the miracles of the apostles, and at the effect which followed the imposition of hands, he offered them a sum of money to be endowed with similar powers. His proposal met with an indignant refusal on the part of Peter; and from the fact of Simon Magus being the first person who attempted to traffic with money in spiritual functions and endowments, the term *simony* has been employed to designate such traffic. (See *SIMONY*.) After this Simon seems to have gone about making proselytes, carrying with him a Tyrian courtesan, whom he represented as Helen who had been the cause of the Trojan war, and sometimes as Minerva, calling her at the same time the first intelligence, or mother of all things. Other stories are related of him, but are not well authenticated. It has also been said that he was worshipped as a god at Rome, and that his statue was erected there, with the inscription, '*Simoni Deo sancto*.' His followers are known by the designation of Simonians.

SIMONOSEKI, SHIMONOSEKI, or AKAMAGASEKI, a town and seaport of Japan, situated at the south-west point of the island of Hondo or Nippon, on the narrow Strait of Simonoseki separating Hondo from Kiushiu, opposite Moji in Kiushiu. Owing to its situation it has rapidly become an important trading centre, connected with the rest of Hondo by railway. The recent war between China and Japan was concluded by a treaty signed here in May, 1895. (See *CHINA*.) The place consists mainly of one long straggling street. Pop. (1901), 44,283.

SIMONY, in English law, so called from its similarity to the offence of Simon Magus (see *SIMON MAGUS*), is the crime of trafficking with sacred things, particularly the corrupt presentation of any one to an ecclesiastical benefice for money or reward. This offence is not punishable in a criminal way at common law, but by an act of Queen Elizabeth it is provided that if any patron, for money or other profitable consideration or promise, present to any ecclesiastical benefice or dignity, both the giver and the taker render themselves liable in the forfeiture of two years' value of the benefice or dignity. Corrupt elections and resignations in colleges, hospitals, and other eleemosynary corporations are punishable in a similar way. The sale of an advowson during a vacancy is not considered a simoniacal offence, and an engagement on the part of the presentee to resign the benefice at a future date in favour of one of two persons to be specially named, who must be either uncles, sons, grandsons, brothers, nephews, or grand-nephews of the patron, is reckoned valid.

SIMOOM, SIMOON, SAMUN (Arabic, *samma*, 'hot' and 'poisonous'), a noxious hot wind which blows at the period of the equinoxes in most countries bordering on sandy deserts, especially in certain parts of Asia and Africa, where its temperature has been known to reach as high as 130°. The

intense and parching heat, resembling that of an oven, is derived from the hot sands, which, in the deserts of Africa and Arabia, often become heated for a depth of some inches to 200° Fahr. This hot sand is whirled up from the earth by the advancing wind, and the whole air is filled with an extremely subtle and penetrating dust, the effect of which, if breathed freely, is to induce suffocation. The approach of the simoom is heralded by a thin haze along the horizon, which rapidly becomes more and more dense, till it covers the whole face of the heavens. This is followed by fierce gusts of wind, accompanied with clouds of red and burning sand, which are whirled round in rapid gyrations, and so swept onwards. Sometimes whole caravans are buried in the masses of sand thus carried along. The simoom generally lasts from six to twelve hours and sometimes longer. When the wind blows in squalls death is often very suddenly produced by actual suffocation, and is followed by bleeding at the nose and mouth. Persons exposed to it protect themselves by stopping the mouth and nose with handkerchiefs, and the camels instinctively bury their noses in the sand at its approach. The effects of the simoom are felt in the south of Europe, the hot wind produced in Italy being called the *sirocco*. In Turkey this wind is called the *samici*; in Guinea and Senegambia a similar wind is called *harmattan*. See *HARMATTAN*.

SIMPLON (Italian, *Sempione*), a mountain, 11,117 feet high, of the Lepontine Alps, in Switzerland, in the east of the canton of Valais, and celebrated for the road that passes over it, which is justly regarded as one of the most celebrated engineering works of modern times. This road commences near Brieg, on the Swiss side, and terminates at the town of Domo d'Ossola, in Piedmont. Begun in 1800 under the direction of Napoleon, it was completed in 1806. It is carried across 611 bridges and through a number of great tunnels, and rises to the height of 6578 feet. A railway tunnel, 66,000 feet long, is in course of construction through the mountain from Brieg on the Swiss side to Ielle on the Italian side. It is expected to cost £2,800,000.

SIMPSON, SIR JAMES YOUNG, M.D., the most eminent medical practitioner of his day, and the discoverer of the anæsthetic properties of chloroform, was born on June 7th, 1811, at Bathgate in Linlithgowshire, where his father carried on the business of baker. Educated in his native place until he attained the age of fourteen, he then proceeded to the University of Edinburgh, where, by dint of frugal living, with the aid of a bursary he obtained in 1826, he made his way with industry if not with distinction, and in 1830 was licensed by the Royal College of Surgeons. Being unsuccessful in an attempt made at this time to obtain the post of surgeon at the small village of Inverkip, he again betook himself to his medical studies, and graduated as M.D. in 1832. The merit of his graduation thesis procured him the appointment of assistant to Professor John Thomson. In this position he soon acquired considerable distinction, and his investigations into the science of obstetrics procured him more than local renown. He was elected one of the presidents of the Royal Medical Society, the membership of which comprised a number of young physicians who aimed at something higher than merely obtaining a livelihood from their profession. He early began to contribute to medical literature, and one of his first papers, On Diseases of the Placenta (1835), possessed such merit as to be translated into different European languages. After acting for one year (1836-37) as house-surgeon to the lying-in hospital in Edinburgh, and lecturing successively during the next two years

on pathology for Professor Thomson, and on obstetrics in the extra-academical school, he was appointed in 1839 to the chair of midwifery in the University of Edinburgh. His election to this chair was strenuously opposed by the whole professorial staff and others, and it was only by the narrow majority of one that his candidature proved successful. One of the objections urged against his election was that visitors would not be drawn to the city, and trade would consequently be affected. The opposition of the professors in no way prejudiced the students against him, and for the first time in the history of the university the class of midwifery was the largest, and the seats in the class-room too few for the audience. The same success continued to attend him from year to year, the increase of his practice keeping pace with his popularity as a teacher. He was frequently called to the remotest districts of the country; and his house, quite a hospital latterly, was thronged by visitors from all quarters of the globe, of all classes—rich and poor, all of whom received equal attention, without regard to social position.

The discovery of the anæsthetic properties of chloroform, with which his name will ever be associated, and likewise the invention of acupressure, are due in the first instance to the tenderness of Simpson's nature, which early urged him to seek some method by which the excessive pain of surgical operations might be mitigated. (See CHLOROFORM.) His first paper on chloroform was read before the Medico-Chirurgical Society of Edinburgh on March 10th, 1847; and notwithstanding a storm of opposition raised by some against the introduction of chloroform, which, however, soon passed away, honours were showered upon him from numerous scientific societies on the continents of Europe and America. In 1853 he was elected a foreign associate of the Academy of Medicine of Paris, an honour at that time held by no other in Great Britain; and in 1856 he received the laureateship and gold medal of the French Academy of Sciences, with the Monthyon prize of 2000 francs, awarded for 'most important services done to humanity.' Acupressure, a mode of arresting surgical hæmorrhage and closing wounds by temporary metallic compression of the arteries, instead of by ligatures, was first expounded by Simpson in a paper read before the Royal Society of Edinburgh in 1859, and afterwards in a more extended form in his treatise on Acupressure (1864). The subject of hospital reform occupied his attention for more than twenty years, and his papers (British Medical Journal, 1869) have contributed greatly towards remedying the great evil known as 'hospitalism.' His great idea was that the unit of a hospital was not the ward but the bed, and the ideal hospital would have every patient absolutely shut off from every other, so that there might be no danger from the inter-contamination that renders the mortality of hospitals so high. Notwithstanding his multifarious engagements, Dr. Simpson found leisure to engage in antiquarian researches. His essays on medical and Scottish antiquities, and on the Great Pyramid of Gizeh, have been collected and edited by Dr. John Stuart (two vols. 1872). Beside academic, he had not a few civic honours conferred upon him. In 1847 he was appointed her majesty's physician-accoucheur for Scotland; in 1856 he was created a knight of the royal order of St. Olaf by the King of Sweden; and in 1866 a baronetcy was conferred upon him. In 1867 he was chairman of the public health department of the Social Science Association, which met at Belfast. In 1868 he was an unsuccessful candidate for the principality of Edinburgh University. He visited Rome in the spring of 1869; and after two hurried visits to

London in February, 1870, which told greatly on his health, returned to Edinburgh only to betake himself to his bed, never again to resume the busy labours of his life. After a long period of intense agony he died on the 6th of May, 1870. Sir James Simpson was characterized by great tenderness of heart, genuine piety, and a genial kindly disposition.

SIMSON, ROBERT, an eminent Scottish mathematician, was born in October, 1687, in Ayrshire. He was educated at the University of Glasgow with a view to the church, but mathematics gained the day over theology, which study he gave up in favour of the former. At the early age of twenty-two he was offered the mathematical chair in the University of Glasgow, in which a vacancy was soon expected. Reluctant, however, to advance at so early an age from the situation of a student to that of a professor in the same college, he solicited and obtained permission to spend one year in London. Here he became acquainted with several eminent mathematicians, from his intercourse with whom he gained still further insight into mathematical science. When the vacancy in the mathematical chair occurred in 1711, he was unanimously elected to the post. Immediately after his admission Simson entered upon the duties of his class with much zeal and success, and continued to discharge these duties the fifty following years of his life. By the advice of Dr. Halley he directed his private studies to the restoration of the ancient geometers. His first labour in this direction was to restore the *Porisms* of Euclid. In 1735 our author published his *Sectionum Conicarum libri Quinque*, a work which he intended as an introduction to the study of Apollonius. The next object of his labour was the *Loci Plani* of Apollonius, which he completed in 1738, but which he did not venture to publish till 1749. He afterwards revised and corrected this work, which greatly extended his reputation, and obtained him a high place among the geometers of his age. The restoration of the elements of Euclid was the great object of Dr. Simson's care, and an edition of the *Elements* was published in quarto in 1756, a work which has always enjoyed a high character both for precision in the definitions and accuracy in the demonstrations. The *Sectiones Determinatæ* of Apollonius next occupied his attention, but this work was not published till after his death, when it was printed along with the *Porisms* of Euclid, and published at the expense of Earl Stanhope. Simson died on the 1st October, 1768, leaving to the university his valuable library. See his life by Dr. Trail (London, 1812).

SIN. Every evil disposition, thought, or action by which the divine law (whether the positive revealed law, or the moral law which God has implanted in the mind of man) is violated, is sin in the widest sense of the word, considered in relation to morals or religion; considered as an offence against the laws of society, an evil act is called a *crime*, *misdemeanour*, &c. Strictly speaking, sin can attach only to an intelligent and free agent, who has or might have a knowledge of the existence and sacredness of the law. The imputation of sin to the transgressor of the divine law is the regarding him as the author of this transgression, and as justly punishable for it. Theologians and moral philosophers distinguish several species of sins, either with reference to the nature of the law which the sinner transgresses, or to the subject against which the sin is committed, or to the sinner, or to the nature and quality of the action itself. In the first point of view sins are divided into those of omission and commission; but this division amounts, in fact, to nothing, because whenever a man sins he omits something which he ought to have done, and commits something which he ought

to have left undone. The same sin may fall under either class, according as we express positively or negatively the moral law which is violated. The moral relations between man and the objects of his duty are much too close to allow an essential difference between omission and commission. Sins are divided, like duties, into those towards God, our fellow-men, and ourselves; but this division is little more than formal, for every sin falls, in some degree, under all three heads. As regards the sinner, sins are divided into premeditated and unpremeditated, the latter being the fruit of sudden impulse and not of deliberate purpose. Moreover, there are internal and external sins (the former include bad appetites, evil thoughts, &c.), conditional and unconditional sins. Sin is often used also for that state of the soul which is properly called sinfulness. Lastly, sin is divided by theologians into original sin (see ORIGINAL SIN) and actual sin; the former again into inherent sin (denoting that corruption of nature which is believed to have been transmitted from the first man to all his offspring), and imputed sin, denoting that liability to punishment to which all the posterity of Adam are subject by the imputation of his transgression. Actual sin is again divided by theologians into mortal and venial. Mortal sins, according to 1 John v. 16, 17, are those the commission of which is followed by spiritual death, that is, the loss of God's grace, and differ from those which may be more easily forgiven.

SINAI is properly the general name of a mountain mass in Arabia Petrea, occupying the southern extremity of the peninsula of the same name which projects between the two forks of the Red Sea, the Gulf of Suez separating it from Egypt on the west, and the Gulf of Akaba separating it from another portion of Arabia on the east. Sometimes, however, the name Sinai, or rather Jebel-Sinai, is used in a more restricted sense, and confined to the culminating mountain of the mass, which is situated not far from its northern edge, and presents a number of magnificent peaks, the loftiest of which rises 8551 feet above sea-level. The whole mass is of a triangular shape, about 70 miles long from north to south, terminating nearly in a point in the latter direction, but gradually widening out till its northern base has a breadth of about 60 miles. It consists of a series of mountains, composed for the most part of granite, syenite, and porphyry, with occasional strata of sandstone and limestone, and intersected by numerous *waddis* or valleys. These are generally mere ravines, deep and narrow, and hemmed in by walls of granite, which in some instances rise almost perpendicularly, so as to form precipices 1000 feet in height. The principal peaks of the mass are Jebel Zebir, which attains an altitude of 8551 feet; Jebel Katerin, 8536 feet; Jebel Umm Shomer, 8449 feet; Jebel Músa, 7375 feet; and Jebel Serbál, 6734 feet. The last was supposed by the earlier church fathers to be identical with the true Sinai whence the law was promulgated; but this does not meet the exigencies of the Scripture narrative, and from the time of Justinian downwards Jebel Músa, or Mount of Moses, has been almost universally regarded as the mountain of the law. The most recent research has tended only to confirm this view. Dr. Beke, indeed, travelling in this region in 1874, believed he discovered Sinai in Mount Barghir, one day's journey north-east of Akaba; but his opinion does not appear to be based on sufficient evidence. At the base of Jebel Músa stands the celebrated monastery of St. Catharine, the buildings of which form a quadrangle, inclosed by walls, averaging 30 feet in height, and strengthened by bastions, which give it all the appearance of a fortress. In the loftier waddis of the Sinai peninsula the moisture is tolerably abundant, and

suffices not only to furnish a spontaneous covering of grass, but to rear shrubs of *Mimosa* and *tamarisk*; but in the lower waddis the vegetation is much more scanty, and the general appearance of the surface is very desolate. See the Ordnance Survey of the Peninsula of Sinai (London, 1872).

SINCLAIR, FAMILY OF. The surname of Sinclair, or St. Clair, is of Norman origin. The first who bore it in Britain was Walderne, count de Santo Claro, who accompanied the Conqueror into England. The son of this count settled in Scotland in the reign of David I., receiving from that monarch a grant of the barony of Roslin. His descendants, among other possessions, obtained also the earldoms of Orkney and Caithness. These Sinclairs are to be distinguished from another branch of the family, the Sinclairs of Hermanston, who derive their descent from Henry de Santo Claro, *vicecomes* of Richard de Morville, chancellor of Scotland, from whom he obtained in 1162 a charter of the lands of Hermanston. Sir William St. Clair of Hermanston distinguished himself so greatly at the battle of Bannockburn that Bruce is said to have presented him with the sword with which he himself had fought on that day. On the sword is inscribed the words, 'Le roy me donne, St. Clair me porte,' and it is still in possession of the family. Sir Henry St. Clair of Roslin swore fealty to Edward I. of England, and seems to have sided at first with the English in the wars of Scottish independence. Subsequently, however, he gave in his adherence to Robert Bruce, from whom in 1317 he obtained a grant of land in the moor of Pentland. Sir William, his son, obtained a further grant of land from the king. This knight accompanied Sir James Douglas to the Holy Land with the heart of Bruce. A son of his married Isabel, a daughter of Malise, earl of Strathearn, Caithness, and Orkney, and by this means the earldom of Orkney came into the family. For the next two generations the power and influence of the family continued to increase, and their mode of living was in a style of princely magnificence. William, the third earl, was one of the most powerful noblemen in the kingdom. Father Hay, a member of his household, speaks of him as keeping a great court, and being royally served at his own table; Lord Dirleton was his master of the household, Lord Borthwick his cup-bearer, and Lord Fleming his carver. His lady, Elizabeth Douglas, was served by seventy-five gentlewomen, of whom fifty-three were daughters of noblemen, and was attended by 200 riding gentlemen on all journeys. In 1446 this earl founded Roslin chapel, bringing skilled workers from abroad to build it, and endowed it with various lands and revenues. This rich and elaborately constructed edifice still continues one of the chief architectural beauties of Scotland. He was high chancellor of Scotland from 1454 to 1458. He was also admiral of Scotland, and as such conveyed the Princess Margaret to France in 1436. In compensation for resigning a claim of right he had to the lordship of Nithdale he obtained a grant of the earldom of Caithness, 28th August, 1455. In 1470 the earldom of Orkney and the lordship of Shetland were purchased by the king from the Sinclairs, and in 1471 they were annexed to the crown by act of Parliament. As compensation for the loss of this earldom the king granted the earl the castle of Ravenscraig at Dysart, in Fife, with several lands adjoining. He was now styled Earl of Caithness and Lord Sinclair. His daughter Catherine married the Duke of Albany, second son of James II. The partition of his lands among his three sons tended to the diminution of the power of this great house. His eldest son William received the barony of Newburgh, Aberdeenshire; his second son, Sir Oliver, received all his lands south

of the Tay; while to his third son, also named William, he conveyed the earldom of Caithness.

**BARONS SINCLAIR.**—The settlement upon Sir Oliver Sinclair of all his father's lands south of the Tay was disputed by his eldest brother, William Sinclair of Newburgh, and Sir Oliver relinquished to him the lands of Cowland, Mid-Lothian, with the barony of Dysart and adjacent lands in Fifeshire, in return for which his brother renounced all title to the barony of Roslin. Henry, a son of the latter, was created Lord Sinclair in 1489, and falling at the battle of Flodden, 9th Sept. 1513, was succeeded by a line of Lords Sinclair who ranked prominently among the higher nobility of Scotland. The third lord was a supporter of the Reformation. The seventh lord having no male issue, and his daughter Catherine having married John St. Clair, younger of Hermanston (the family already alluded to), the son of this marriage became eighth Lord Sinclair. In this title he was confirmed by letters patent from Charles II., dated June 1, 1677, and he subsequently procured an extension of the patent to the heirs male whatsoever of his father. Thus the title went to the Sinclairs of Hermanston, who have retained it ever since.

**SINCLAIRS OF ROSLIN.**—The above-mentioned Sir Oliver, son of the third Earl of Orkney, had five sons, and was the progenitor of a line of barons who for two centuries continued in possession of the Roslin domains. Sir Oliver Sinclair, his third son, was the celebrated favourite of James V., who had command of the Scottish army at the rout of Solway Moss in 1542. His fourth son became Dean of Restalrig; it was he who married Queen Mary and Lord Darnley. The last of Sir Oliver's line sold the estates of Roslin to one of the sons of the eighth Lord Sinclair, and these estates, together with those of Dysart, were carried by destination to the issue of the eighth lord's second daughter, whose grandson, Sir James St. Clair Erskine of Alva, succeeded his uncle as second Earl of Rosslyn in 1805.

**EARLS OF CAITHNESS.**—This title, as mentioned above, was conferred on William Sinclair, third earl of Orkney, who left it to his second son, William; and this son obtained a charter of the whole lands of the earldom, &c., to himself and his heirs, 7th Dec. 1476. From him the present branch of the family which now enjoys the title is remotely descended. An attempt made in 1529 by the third earl to take forcible possession of Orkney resulted in a signal defeat. The sixth Earl of Caithness, being deeply involved in debt, executed in 1672 a deposition of his titles, estates, and heritable jurisdictions in favour of Sir John Campbell of Glenorchy, his principal creditor, who was accordingly created Earl of Caithness in 1677, after the decease of this earl. Sir John Campbell, however, was ultimately obliged to relinquish the title in favour of George Sinclair of Keisa, a grandson of the fifth Earl of Caithness, and was afterwards created Earl of Breadalbane. The Sinclairs of Ulbster, from whom came Sir John Sinclair (see SINCLAIR, SIR JOHN), are a branch of the noble house of Caithness.

Among other branches of the Sinclair family may be mentioned the Sinclairs of Dunbeath, Inverness-shire, of Longformacus, Berwickshire, and of Stevenson, East Lothian.

**SINCLAIR, SIR JOHN, Bart.**, a very active and useful agriculturist and general statistic, was born at Thurso Castle, in the county of Caithness, May 10, 1754, and received his education consecutively at the Universities of Edinburgh, Glasgow, and Oxford. In 1775 he became a member of the Scottish bar, and was afterwards called to the English bar, but he did not follow out the profession of the law. In 1780

he was elected member of Parliament for the county of Caithness, where his estates were situated; and he had also the same honour conferred on him at the elections in 1790, 1802, and 1807. In 1785 he engaged seriously in inquiries on political subjects in general, and collected a mass of materials from different sources. The first published form which part of these assumed was in an essay on the Public Revenue of the British Empire. In 1786 he was created a baronet. In 1790 the idea of that great national undertaking, the Statistical Account of Scotland, had suggested itself to the mind of Sir John Sinclair; and being a lay member of the Assembly of the church it occurred to him that he might be able to prevail on a great proportion of the clergy to furnish such general information regarding the state of Scotland as should afford data for an estimate of the political situation of that portion of the United Kingdom. After unwearied exertions, in which he was ably seconded by the clergy, Sir John succeeded in bringing the first volume of this great work before the public on the 25th May, 1791, just a year after its suggestion to the members of the church; and on the 1st of January, 1798, seven years and a half after its commencement, the work was brought to its completion. It was comprised in twenty thick octavo volumes, and to these another was subsequently annexed. In May, 1793, Sir John printed and circulated a plan for establishing a board of agricultural and internal improvement; and shortly afterwards carried in Parliament an address to the crown in favour of the proposed establishment. The board soon after was not only appointed, but received a charter from the crown, in which Sir John was nominated its first president. In 1803 he published an elaborate work, in three octavo volumes, under the title of a History of the Public Revenue of the British Empire. About the year 1797 he was led to the consideration of the subject of health, and the result of his investigations was a pamphlet in 4to, published in 1803, entitled Hints on Longevity. The attention excited by this pamphlet both at home and abroad led him to the publication of a larger work on the same subject under the title of a Code of Health and Longevity (four vols. 4to), in which were condensed the researches of both ancient and modern authors. This was followed in 1819 by his Code of Agriculture, a work which has gone through several editions and translations. Besides the works which we have specified, Sir John published a great variety of smaller pamphlets and tracts, all bearing on points of agriculture or political economy. He died in George Street, Edinburgh, on the 21st Dec. 1835.

**SIND, SINDH, or SCINDE** (from *sindhu*, a collection of waters), an extensive territory of British India, included in the Presidency of Bombay, comprising the lower course and delta of the Indus, and situated between lat. 23° 32' and 28° 50' N.; and between lon. 66° 35' and 71° 18' E.; bounded on the west and north-west by Baluchistan and Afghanistan; north-east by the Panjab; east by Rajputana; and south by the Runn or Ran of Kach and the Indian Ocean; length, north to south, about 380 miles; greatest breadth, east to west, 280 miles; area, estimated at 48,014 square miles. It is divided into five collectorates, Haidarabad, Karachi, Shikapur, Thar and Parkar, and Upper Sind Frontier. The capital is Haidarabad, the chief port Karachi, which is connected with it by railway. Its sea-coast, except at the western extremity (Cape Monza), is very low, being composed of mud-banks deposited from the rivers of the delta, or of low hills of sand blown in from the beach, the whole shore being a dreary swamp, destitute of trees or shrubs, and sub-

merged at spring tides. For several miles inland, also, the delta is frequently overflowed by the tide, and covered with water during the summer months. In the dry season the stiff clay-soil, which is strongly impregnated with nitre, bears an abundant crop of gigantic grass, with furze, mimosa, and cacti, and affords pasture to numerous herds of buffaloes. The alluvial tract farther north, which skirts the Indus from 2 miles to 10 miles on either side, is, like the delta, intersected with canals and water-courses, but very superior to it in appearance, soil, and cultivation—possessing, indeed, a fertility exceeded by that of no tract of country anywhere known. East stretches a region mostly alluvial, but which, from its having been deserted by the river, has become a desert of indurated clay; it is chiefly level, but traversed by two low ranges of tertiary limestone and flinty chalk, and in some parts covered with shifting sand-hills, affording pasturage throughout its extent for camels, buffaloes, oxen, sheep, and other herbivorous animals. West of the Indus the Hala Mountains approach the river at Sihwan, and come close to the sea at Cape Monza; and between the former place and Karachi, on the north-west mouth of the Indus, is a maze of hills, the highest of which reach an elevation of about 1500 feet, terminating abruptly on the west bank of the stream. North of Sihwan (lat. 26° 21' N.), which is considered to mark the division between Sirra or Lower, and Lar or Upper Scinde, the country improves in its aspect; but with regard to Scinde as a whole, Captain Postans well observes—‘Its general appearance is that of a jungly wilderness; and spontaneous vegetation takes the place of cultivation.’

The climate is remarkably dry and sultry, the country being seldom visited by rain. The mean temperature of summer at Sakliar in the extreme north is about 102° Fahr., and even the waters of the Indus at that season attain a warmth of 92°. In the upper districts frost is not unknown, and the heat often varies in the twenty-four hours from 40° to 84° Fahr. The hot season lasts from March to September, the cold from October to March; and the changes from the one to the other are so rapid, that spring and autumn are not experienced. The exhalations, caused by the evaporation during summer from the stagnant waters and rank decayed vegetation, are extremely injurious to health.

The husbandry of the Scindians is of the rudest kind, their implements being very few, and of the simplest construction. The northern districts not visited by the floods are artificially irrigated either by the Persian wheel, worked by a camel, or by simply opening drains and canals leading to low-lands. In those parts that are under tillage the land yields two crops annually; the spring crop consisting of wheat, barley, millet, sesamum and other oil-seeds, hemp, opium, and tobacco; the autumn crop of rice, maize, cotton, sugar, and indigo. Rice, wheat, and maize form the principal staples, being both extensively used for food and exported. Pulse, pumpkins, and other succulent plants are raised in either season. The date, mango, plantain, pomegranate, lime, citron, tamarind, fig, mulberry, pistacia, melon, grape, &c., are amongst the principal fruits. Date-palms are planted in considerable numbers. In moist situations gigantic grasses abound. The wild animals include the tiger, panther, hyena, jackal, wolf, fox, antelope, and other kinds of deer, wild ass, wild hog, &c. The domestic animals include camels, buffaloes, horses, sheep, and goats. The camels are valuable, both as beasts of burden and as furnishing a rich milk, and hair for shawls and cloths; the buffaloes are prized for their hides, flesh, and milk, of which last *ghee* is made, which is an import-

ant article of traffic in Indian commerce. Birds are in great variety. Fish form a chief part of the food of the humbler orders of people. Venomous snakes, scorpions, and centipedes are common.

The Scindians, a mixed race of Jats and Baluchis, are partly of the Hindu and partly of the Mohammedan faith. They are described as well made, and handsome; tall, inclined to corpulence, and of dark complexion; and the women are particularly noticeable in the East for their beauty. The moral character of the people is low. The language differs little from the pure Hindi of Upper India, though more regular and complete in the inflections of its nouns and verbs. Baluchi is also much spoken, especially in the districts west of the Indus; and Persian may be considered as the language of the higher orders. The natives are very ingenious as weavers, turners, and artisans, and are specially noted for their skill in the production of wooden lacquer-work, famed throughout India. The leading textile fabrics are coarse silk, cotton, or mixed cloths. The coarse silk goods are woven from silk imported from China and Persia. The manufacture of the many-coloured Scindian caps forms also an important branch of industry. The Scindians are likewise renowned for the preparation of very soft and durable leather. Scinde imports British manufactured goods, sugar, groceries and spices, raw silk, &c. Its exports, principally its own productions, comprise rice and other grains, ghee, indigo, potash, dried fish, wool, hides, &c. There is a transit trade with the Panjab, Persia, and Afghanistan, which has been improved by the introduction of steamers upon the Indus. The harbour of Karachi has recently been improved at considerable expense, and the trade is increasing.

Scinde was governed by Hindu rajahs at the time of its invasion by Alexander the Great, but subsequently, after many changes, it became an independent state. It was finally subdued by the Emperor Akbar in 1580, since which period it has always been either nominally or really tributary. In 1739 it fell under the power of Nadir Shah, but on his death it reverted to the imperial sway of Delhi. It was, in 1756, presented by the Mogul court as a dowry to Timur Shah Derani, king of Cabul, to which country it was (down to its late annexation to British India) deemed subordinate. The country, however, was, during the whole of the eighteenth and the early part of the nineteenth century, a scene of almost constant civil dissension, caused by disputes between the two leading tribes of Baluchis, which led at last to the elevation of the Talpur dynasty of the ‘Ameers’. The government under these Ameers was a wholly unchecked military despotism, upheld by a feudal soldiery, supported by their respective chieftains, and estimated to have numbered about 102,000 men just before the final cession to the British. The hostility displayed by the Ameers of Sind against the British, during and after the operations against the Afghans, led ultimately to its invasion by British troops, and final conquest by Sir C. Napier's victory at Miani, February 17, 1843. Sir C. Napier was appointed its first governor, and it was soon after annexed to the Presidency of Bombay. Pop. (1881), 2,413,823; (1891), 2,871,774; (1901), 3,210,910.

**SINDHIA'S (SCINDIA'S, or GWALIOR) DOMINION**, a Mahratta state of India, nearly in the centre of Hindustan, now dependent upon Britain, and forming part of the Central Indian Agency. It stretches very irregularly between lat. 21° and 26° 40' N.; and lon. 73° 40' and 77° E.; has a length north-east to south-west of about 420 miles, and an area of 29,046 square miles. The main portion of it, forming the Gwalior assistant agency, lies between Rajputana and the North-west Provinces; other portions

of it are contained in the Indor Residency, and the Bhopal, West Malwa, Bhopawar, and Guna assistant agencies, between the Central Provinces and Rajputana. The surface is mostly undulating, with a general slope to the north, where it comprises a part of the great plain of the river Jamna; in the south portions of it are traversed by the Vindhya Mountains. The Chamba partly bounds it on the north-west; other rivers are the Sind, Betwah, Dussam, &c., tributaries to the Jamna with their affluents, having mostly a northern course; south of the mountains the Narbada carries part of the drainage to the west. The soil is generally of high fertility; the villages are numerous, according as the opium-poppy is an object of culture. The opium, raised chiefly in Malwa, is subjected to a heavy export duty at Bombay, its only legal port of export, in order that it may not have an advantage over the heavily-taxed opium grown in British territory. An abundance of corn and oleaginous plants, the sugar-cane, barley and pease on the dry lands in winter, cotton and tobacco, are raised. The cotton is of short staple; the tobacco of Bhilsa, &c., is highly valued throughout Western India. The population are mostly Mahrattas, but include also Bheels, Minas, and Coolies, numerous Brahmans, a few Rajputs, and a peculiar sect of Mohammedans called *Bhoras*, who are supposed to be of Jewish origin. The chief towns are Gwalior (the capital), Ujjain, and Mundior. This state was founded after the successes obtained by the Mahrattas over the Mogul forces in 1738, by Sindhia, a chief who raised himself from obscurity into eminence by his own merits. In 1781 Madaji Sindhia negotiated a peace between the British and the Mahrattas, and about the same period he introduced European discipline and tactics into his army; possessed himself of Delhi, Agra, and the person of the Mogul emperor, in whose name he subsequently acted, and was the most powerful member of the Mahratta Confederacy. His successor, Dowlut Rao Sindhia, in conjunction with the Rajah of Berar, advanced with hostile forces towards Puna in 1803, but his troops were defeated by those under the Duke of Wellington at Assaye, and again at the battles of Delhi and Laswari, by those of Lord Lake; and, in consequence, all his territories north of the Jamna, and south of the Ajanti Hills in the Deccan, together with the fort of Baroach, &c., were ceded to the British, and he ceased to exercise control over the person of the Great Mogul. In 1818 Sindhia ceded Ajmir, Islamnagar, and other places to the British, in exchange for some of equal value. Few changes of importance in the foreign relations of the state occurred from that period till 1843, when soon after the accession of an infant maharajah a turbulent army, conjectured to amount to nearly 50,000 men, was collected at the capital, and the British beyond the frontier were threatened with hostilities. After the battles of Maharajpur and Punnair, December 29, 1843, in which the British troops were victorious, a new regency was appointed to act in accordance with the advice of the British resident during the maharajah's minority, and the state, which had previously been nominally independent, was constituted subsidiary to the Anglo-Indian government. Pop. (1891), 3,071,524.

SINE, in mathematics, one of the most commonly used trigonometrical ratios of an angle. With the usual notation it is the ratio of the perpendicular to the hypotenuse. The sine of an arc is the sine of the angle subtended by the arc. In plane triangles the sides are to each other as the sines of the opposite angles; in spherical angles, the sines of the sides are to each other as the sines of the opposite angles. Hence it appears how important the sine

is for finding certain parts of triangles, from certain given parts.

SINECURE (Latin, *sine cura*, 'without care'), an office which has revenue without any employment. In the canon law *sine cure* is an ecclesiastical benefice which has no duties, or only nominal duties, attached to it. Sinecure rectories are now abolished by acts 3 and 4 Vict. cap. cxlii. and 4 and 5 Vict. cap. xxxix.

SINGAPORE, a British possession, forming one of the Straits Settlements, and consisting of a small island and its capital of same name, with numerous surrounding islets off the southern extremity of the Malay Peninsula (opposite the state of Johore), and separated from the mainland by a narrow strait 2 miles to  $\frac{1}{2}$  mile in breadth. The island of Singapore is of rhomboidal shape, about 27 miles long and 14 miles broad; area, 206 square miles. Its surface is generally undulating, rising in some parts into round verdure-clad hills, the highest of which (called Bukit-Tima or the Tin-hill) rises 520 feet above the sea. Near the coast are some low tracts of a swampy character, flooded daily by the tides. The island has no rivers, but has several rivulets, on one of which stands Singapore, the capital. The climate resembles that of Malacca in its equability, but from the absence of regular alternations of land and sea breezes it is considerably hotter. The thermometer annually ranges between 71° and 89° Fahr., the average summer-heat (May and June) being 84°; the temperature of the colder months (December and January), 76°. Though only 76 miles from the equator the island is remarkable for salubrity. It has the advantage of frequent refreshing showers; its foliage is in consequence always in the full bloom of summer. The greatest quantity of rain falls in December and January, and the total annual fall averages about 102 inches, nearly a half less than that at Rangoon. The soil, where of sufficient depth, is well adapted for the growth of tropical products, but is not on the whole particularly fertile. The island was at one time covered with forest and jungle, but this has to a great extent been cleared away. Eucalyptus and other trees, however, have recently been planted, it being deemed desirable to have a greater production of timber in the colony. One of the chief trees of the island is the cocoa-nut palm. The gutta-percha tree was once plentiful, and is being reintroduced. Nutmeg trees still exist, but are no longer of commercial importance. The chief cultivated plants include coffee, pine-apples and other fruits, cocoa-nuts, aloes, gambier, pepper, indigo, sugar-cane, &c. Fruits are grown in immense variety and to great perfection, including all those of this region of the world, and others introduced. Vegetables in abundance are raised. Agar-agar (a delicate fern-like sea-weed) is plentifully found on the neighbouring coral-reefs and shoals, and is an important article of commerce for the China and eastern markets. The mammals include wild hogs, deer, monkeys, squirrels, &c.; tigers now only occur as unwelcome visitors from the mainland. Among the birds are pea-fowl, pheasants, partridges, &c. Amongst reptiles are turtles, tortoises, crocodiles, the black cobra, and other varieties of serpents. The coast and rivers abound with fish—soles, mullets, rays, sharks, &c., with crabs and prawns and other Crustacea.

The town of Singapore is situated on the south side of the island, on both banks of a creek or rivulet of same name, and altogether from south-west to north-east it has a sea frontage of about 6 miles. The central and best part of the town is laid out in regular streets, lined with substantial brick houses; and towards the shore is ample space for parade and

carriage-drives. Here are the principal public offices, official residences, hotels, and churches. The chief of the churches are the English and the R. Catholic cathedral. Other edifices include the supreme courts, the post-office, the town-hall, the police courts, &c. On a hill north of the town is the government-house, a fine building with beautiful grounds. The higher classes of the European merchants, &c., generally live in bungalows or garden-houses in the suburbs and along the beach east of the town, which commands fine views of the harbour and both its entrances. The retail trades of the town, chiefly engrossed by the Chinese, are for the most part carried on in the streets; but well-supplied shops are not wanting. The manufactures and similar industries of Singapore are few, the principal being tin-smelting, the tinning of pine-apples, and biscuit-making. Its fisheries are very productive, and give employment to a large number of people. Some of the Chinese make pretty good artificers of various kinds. Singapore enjoys so high a commercial reputation, and carries on such extensive transactions as a trading colony, that it has been termed 'the Liverpool of the East'. It has, in fact, become the great entrepôt of Southern Asia and the Indian Archipelago, to which the inhabitants of all parts of the Indian Ocean resort with the produce of their farming and manufacturing industry, and in which they find a ready market abundantly stocked with every variety of European goods. The port also has the advantage of being perfectly free to vessels of all kinds and nations, without charges on exports and imports, anchorage, &c., only light dues being payable. Large graving and other docks have recently been constructed, including an admiralty dock. Singapore is now a coaling-station of the British navy, and is defended by forts carrying heavy ordnance, and by submarine mines. The imports from Great Britain comprise cottons (the largest import), iron, machinery, coals, hardware, and various manufactures; the exports thither consisting of tin, coffee, rice, sugar, nutmegs, mace, sago, tapioca, catechu, gambier, hides, rattans, gutta-percha, and very numerous sundries. The imports from the continent of Europe and the United States consist of wines, spirits, and liqueurs, manufactured goods, provisions, &c., in exchange for similar commodities to those sent to Britain. Singapore also carries on an extensive trade with Calcutta, Madras, and Bombay. The annual value of exports from and imports into Singapore, taken together, is as much as from £40,000,000 to £50,000,000. A railway has been constructed from Singapore to Kranji, on the Johore Straits. The town is well supplied with water, but in other respects its sanitary arrangements are somewhat backward. Singapore is the capital of the Straits Settlements and the place where the governor resides. The revenue amounts to about £500,000. The currency consists of Mexican and British dollars, both valued at just over 2s. Pop. in 1901, 228,555 (mostly in the town), including about 3000 whites.

The island of Singapore is celebrated in Malayan history as having been the first place of settlement of the early Malay colonists from Sumatra. Their location there took place towards the middle of the twelfth century, and the lines of the ancient town Singhapura (Lion Town) were still traceable in 1819. Nearly a century afterwards the island was invaded and the city taken by the Javanese, who, however, did not make any permanent settlement, though the Malays were driven north to Malacca, where they founded a new kingdom. After this event the town seems to have fallen into decay, and the country to have been abandoned; for when the British (after having restored Malacca to the Dutch at the

conclusion of the great Continental war) wished to form a settlement in this neighbourhood, in order to preserve their trade with the Indian Archipelago, they found on their arrival at Singapore, which then belonged to the Kingdom of Johore, in Malacca, that the whole island had only 150 inhabitants. It was by the sagacity of Sir Stamford Raffles that the happy choice was made of Singapore for the site of the present flourishing commercial emporium. From the then resident officer or chief the British in 1819 obtained permission to build a factory on the southern shore of the island; and by treaty in 1824 purchased for 60,000 Spanish dollars (£13,500) and a life-annuity to the Sultan of Johore and his resident officer of 24,000 dollars (£5400), the sovereignty and fee-simple of the island, as well as of all the seas, straits, and islands to the extent of 10 geographical miles (11½ miles) around. See STRAITS SETTLEMENTS.

SINGBHUM, a district of Hindustan, in Bengal; area, 3753 square miles; pop. 453,775.

SINGING. See VOICE.

SINGING FLAMES. A small gas flame, when surrounded by a glass tube, produces a musical note which depends on the length of the tube, just as the note from an organ pipe depends on the length of the pipe. Faraday first properly explained the notes of singing flames as being due to the explosions of the burning gas strengthened into musical notes by the resonance of the glass tubes. A very loud sound may be produced by introducing a small hydrogen flame into the end of a glass tube; there must be a free circulation of air through the tube, and in moving the hydrogen flame up or down a point is found where the best effect is produced.

SING-SING, a town of the United States, pleasantly situated on a commanding height above the left bank of the Hudson, in the state and 30 miles north of the town of New York. Its chief edifices are Episcopal, Presbyterian, Methodist, and Baptist churches, an academy in a structure built of marble, and a large state prison or penitentiary, situated in an inclosure of 130 acres, and consisting of a hollow square of lofty buildings with cells for 1600 prisoners. An aqueduct of the Croton water-works, which supply New York, spans Sing-Sing Creek by a single arch, 88 feet wide and 100 feet high. Pop. (1880), 6578; (1890), 9352.

SINIGAGLIA (anciently *Sena Gallica*), a fortified seaport town of Italy in the province of Ancona, at the mouth of the Misa, 17 miles w.n.w. of the city of Ancona. It is in general well and regularly built. Its port is small, and only admits small vessels, but is advantageously situated for trade. Its fair, one of the largest in Italy, has existed annually for about 600 years; it continues from July 20 to August 8, and is attended by dealers from all parts of Italy, from beyond the Alps, and from the Levant. Sinigaglia was founded by the Senonian Gauls, and received a Roman colony in A.C. 289. Pop. (1881), 9602.

SINKING FUND, a term applied to a scheme followed in Great Britain for a number of years, by which it was expected to bring about the gradual extinction of the national debt. This scheme was first projected in 1716 by Sir Robert Walpole, but it was only partially applied at that time. It was reserved for Pitt in 1786 to give it a fuller development and propound it in such a form as to give it a greater show of reality. By the scheme of Mr. Pitt the sum of £1,000,000 sterling was to be annually set apart from the income of the country towards the extinction of the debt. Other sums were rendered available for the same purpose, and it was supposed that at the expiration of twenty-eight years the annual income of the sinking fund would

amount to £4,000,000, a part of which might then be applied to the liquidation of the public debt. Had this plan been adhered to in its integrity—had the sum thus set apart from the revenue of the country been an actual surplus over the expenditure, it would follow, of course, that in process of time, by its application to this purpose, the debt would be wholly extinguished. But this was not the case; the fund was not kept up by the application of surplus revenue, but by sums borrowed for the purpose; and in this consisted the fallacy of the scheme. It was absurd, as was afterwards shown, to suppose that the debt of the country would be actually lessened by borrowing for the purpose, and thus incurring new liabilities. Not, however, until the scheme had been in operation on an enormous scale for a quarter of a century was it clearly shown to be based on a fallacy. Instead of a diminution of the debt in that time by more than £200,000,000, which had been apparently redeemed, the debt was actually increased by the scheme. This was due to the less advantageous terms upon which the money was borrowed, compared with the terms upon which an equivalent amount of debt was redeemed. The difference between the average rates at which money was borrowed and at which purchases were made by the commissioners who managed the sinking fund between 1793 and 1814 was such that, through the operations of the fund, the country owed upwards of £11,000,000 more at the end of the war than it would have done but for these operations. The futility of the scheme was fully demonstrated in 1813 by Dr. Hamilton in his Inquiry concerning the Rise and Progress, &c., of the National Debt of Great Britain; but it was not till the year 1824 that the plan of keeping up a large nominal sinking fund in the absence of actual surplus revenue was abandoned. A scheme of a similar nature to the sinking fund, but intended to deal only with surplus revenue, was projected in 1875 by Sir Stafford Northcote (Lord Idlesleigh), chancellor of the exchequer.

**SINOPE** (Turkish, *Sinoub*), a seaport of Asiatic Turkey, beautifully situated on the neck of land connecting the rocky peninsula of Cape Sinope, in the Black Sea, with the mainland, 350 miles E.N.E. of Constantinople. It is inclosed by a wall flanked with towers and defended by a castle and several forts, and is built to a considerable extent out of the ruins of an ancient Greek city. Its harbour is the best on the south shores of the Black Sea, and it has a naval arsenal and a building-yard, at which many vessels are built. On November 30, 1853, eighteen Russian ships here attacked and destroyed a Turkish flotilla consisting of six frigates, three corvettes, and two steamers, manned by about 4000 men. Sinope is a place of very great antiquity. It was the birth-place of Diogenes and the capital of Mithridates the Great. Pop. about 10,000.

**SINTER**, incrustations on rocks, derived from mineral waters. Various adjectives are prefixed to the name in order to indicate the nature of the deposit; thus we have *calcareous sinter*, *siliceous sinter*, *ferruginous sinter*, &c.

**SION** (German, *Sitten*; ancient, *Sedunum*), a town of Switzerland, capital of the canton of Valais, pleasantly situated near the right bank of the Rhone, 58 miles east of Geneva. It has walls with ancient towers, a principal street planted on either side, and containing several good houses, a Gothic cathedral, a Jesuit church, a beautiful Gothic town-house, an arsenal, and an hospital. Close to the town is a steep hill divided into two parts, each crowned by a castle, the one in ruins, but the other surrounded by lofty walls and towers, and of very imposing appearance. Pop. in 1888, 5447.

**SIOUT**, or **ASROOT** (ancient, *Lycopolis*), a town of Upper Egypt, capital of a province of the same name, situated in a fertile district near the left bank of the Nile, 247 miles from Cairo by railway. The town is about three-quarters of a mile west of the river. Its main street, running east and west, is about 3 miles in length. Among the chief buildings of the town are the railway-station, the government buildings, a good hospital, public baths, an American Presbyterian mission station, with schools; mosques, bazaars, &c. Near the town are some ancient rock tombs. Siout has a trade in excellent pottery, linen, leather goods, carved ivory, natron, soda, and corn. Plotinus, the great Neo-Platonic philosopher, was born here in 205 A.D. Pop. (1897), 42,076.

**SIOUX** (or **DAHCOOTAH**) **INDIANS**, a family of Indian tribes dwelling to the west of the Mississippi. See **INDIANS** (AMERICAN).

**SIPHANTO**, or **SIPHOS**, an island of the Cyclades, in the Grecian Archipelago, about 12 miles west of Paros; greatest length, north to south, 11 miles; breadth, 5 miles; area, 42 square miles. It has a finely-diversified surface, good climate, and fertile soil, and has a considerable trade in its produce, consisting chiefly of cattle, corn, fruit, vegetables, and silk. It has manufactures of pottery, cotton goods, &c. It possesses marble quarries, and was once celebrated for its gold and silver mines. Pop. (1898), 4060.

**SIPHON**, a pipe through which a liquid may, by the action of gravity, be transferred from one place to another place at a lower level over an obstruction which must be lower than a height which depends on the specific gravity of the liquid. Water may be siphoned over obstacles which are less than 32 feet higher than the surface of the water, and the quantity of water carried depends on the difference of levels at the two sides of the obstacle, and is not influenced by the height of the obstacle farther than to the extent due to the increase of friction in an increased length of pipe.

Suppose that two barometer tubes, about 40 inches long each, are united by a length of straight pipe of a very fine bore, giving communication from points about 32 inches from the open ends, so that the arrangement will look like the letter H; two troughs, deep enough to admit of the tubes being raised or lowered some distance, while the ends will remain below the liquid, are placed on the same level, and filled to the same height with mercury; the barometer apparatus is now filled with mercury, and inverted over the two troughs so that one pipe is in one trough and the other pipe in the second trough. The mercury will fall in the tubes, leaving the usual vacuum space, till it stands about 29 inches above the surface of the troughs. If the tubes are raised the vacuum space increases, and can be made to include the space of the horizontal cross pipe; if they are lowered, the vacuum spaces can be made to disappear altogether. If, now, the tubes being kept so that there is still some vacuum space, the surface of the mercury be lowered in one of the troughs say 1 inch (neglecting friction and *vis viva* in the barometer tubes), the mercury in that tube will fall 1 inch, so as to maintain its 29 inches above the trough, and there will be a head of 1 inch of mercury forcing the mercury through the horizontal tube into the second barometer tube. It is thus seen that the current is due to the difference of levels between the surfaces of the two troughs. If the apparatus is raised, while the difference of levels is maintained, till the horizontal tube is included in the vacuum space, no mercury can flow, although the difference of levels will remain. It is thus seen why a siphon will not act beyond a definite limit. We have used a siphon of peculiar shape to illustrate the

principle, but it does not matter in the least what is the shape of the pipe. The reason why mercury stands in a barometer tube is explained in the article *BAROMETER* (which see). Mercury is a little more than thirteen and a half times the weight of water, and so 29 inches of mercury nearly corresponds to 32 feet of water.

The siphon is applied to a variety of uses. We have seen it employed to draw off the lower portion of a solution in a delicate chemical experiment, and we have seen it used for conveying great quantities of water out of extensive stone quarries. The siphon is very liable to be misunderstood; we have heard it proposed by a practical man, otherwise well-informed, to lift water by means of a siphon so as to give it additional force in driving a water-wheel; and an eminent engineer, in a conversation with the author, related an instance of a proposal by a gentleman, intrusted with large sums of money, to convey water by means of a siphon over a hill some hundreds of feet high.

**SIPHON**, the name applied in zoology to the tubes through which water has egress from, and ingress to, the respiratory or breathing organs of Mollusca. The siphons in Lamellibranchiata are prolongations of the mantle-lobes, and also exhibit a muscular structure. They are not present in all Lamellibranchiata, and are found chiefly in those forms which pass their lives buried amid mud or sand (such as *Mya*), or in burrows in rocks, wood, &c. (such as *Pholas*, *Teredo*, &c.). The siphons may be free or united, and are usually capable of being retracted within the shell by means of special muscles. An inspection of the shell of any Lamellibranchiate will afford definite information as to whether or not the contained animal possessed siphons. Thus, where no siphons exist, the *pallial line*, or the line which marks the attachment of the mantle round the edge of the shell, is entire or unbroken in its conformation; as is also the case where siphons have been present, but were small and non-retractile. But in cases where the siphons were retractile the pallial line exhibits an indentation or curve in its course, this indentation being named the *pallial sinus*, and corresponding to the site or implantation of the retractor muscles of the siphons. See *MOLLUSCA*.

In many *Gasteropoda* breathing-siphons also exist, an anterior and posterior siphon being present in many cases; and of these two tubes the anterior forms the inhalant and the posterior the exhalant tube. In such *Gasteropodous* forms as the *Whelks*, *Cowries*, &c., the aperture or mouth of the shell may be notched either in one or two places, for the passage of the breathing-siphons. Shells thus notched are termed *siphonostomatous* shells, whilst those which have the shell-aperture entire and unindented are in contradistinction termed *holostomatous* shells.

**SIPHONOPHORA** (see *PLATE PROTOZOA*), an important group of Hydrozoa (Cœlenterata) generally regarded as constituting a sub-class or chief subdivision of that class. The Siphonophora are otherwise named *Oceanic Hydrozoa*, and in their free-floating lives present marked contrasts to the other, and generally rooted members of the class. These organisms are all of composite or compound nature. They are delicate organisms, and are generally provided with *nectocalyces* or 'swimming-bells', and a pneumatophore or 'float'. The Siphonophora are divided into two orders. Of these the order *Calyptophoridae* is represented by the beautifully delicate forms *Diphyes* (see *PLATE PROTOZOA*, fig. 1), *Praya*, &c. The Physophoridae are represented by the 'Portuguese Man of War' or *Physalia* (fig. 2), by *Vedella* (figs. 3, 4, 5), and other less familiar forms.

**SIPHONOPS**, a genus of Amphibian Vertebrates

belonging to the Ophiomorpha or Gymnophiona—the lowest order of that class, which also includes the familiar *Cœciliidae* of tropical marshes. *Siphonops annulatus*, the Ringed Siphonops (see *PLATE BATRACHIANS*, fig. 1), is a well-known example of this genus. The skin does not possess the horny scales seen in other members of the order. Numerous ribs exist, but no sternum or breast-bone is developed.

**SIPUNCLE**, the name given to the membranous tube which runs through the *septa* or partitions of the many-chambered shell of the Pearly Nautilus (*Nautilus Pompilius*). (See *NAUTILUS*.) In extinct *Tetrabranchiate* shells, of which the Nautilus is the only living example, a sipuncle also existed. In the family *Nautilidae* (genera *Nautilus*, *Orthoceras*, *Lituites*, &c.) the sipuncle pierced the *septa* centrally, sub-centrally, or on the concave (*internal*) side of the curved shells. In the remaining family *Ammonitidae* (*Ammonites*, *Baculites*, *Turrilites*, *Ancylloceras*, &c.) the sipuncle is situated on the convex (*external*) side of the curved shells. A sipuncle also existed in the internal shell of the extinct *Belemnites*, and was marginal in its position; and one also exists ventrally in the internal chambered shell of the *Spirula* (which see).

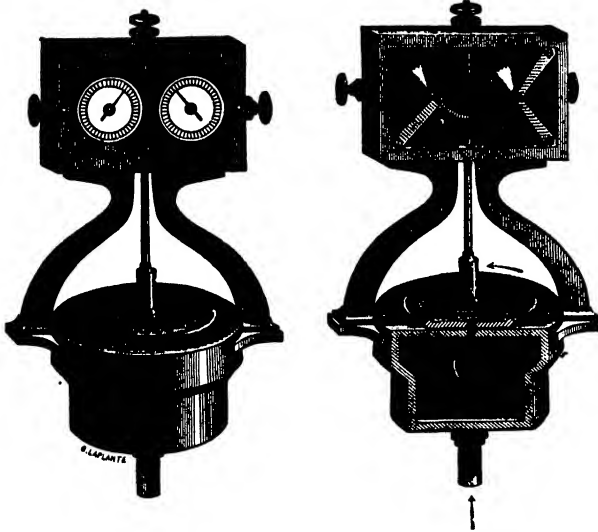
**SIR**, a term of courtesy, applied in Great Britain, without distinction of rank, to all persons. It is also the special title of knights and baronets, and as such is always prefixed to the Christian name.—*Sire* is a term of respect by which kings are addressed. The word *sir* is the same in origin as *sire*, and is derived from old French *seur*, and that from *senior* (Latin, elder), whence also *scignior*, *signor*, similar terms of courtesy.

**SIRACH**, SON OF. See *JESUS*.

**SIR-DARIA**, **SYR-DARIA**, **JAXARTES**, or **SIRON**, a river in Central Asia, which rises on the north side of the Thian-Shan Mountains, flows westward, passing through the Russian district of Ferghana, and then north-west through that of Sir-Daria, both belonging to Russian Turkestan, and latterly enters the Sea of Aral. Its total course may be estimated at 1780 miles. It flows mostly through an infertile region, and there are few important places on its banks, the chief being Khojend, where it turns to the north-west. It is of little importance for navigation.

**SIREN**, or **MUD-HEL** (see *BATRACHIANS*, fig. 19), a genus of Amphibian Vertebrates, belonging to the order Urodela, and to the Perennibranchiate ('persistent-gilled') section of the order. This genus forms the type of a family of Urodela known as that of the Sirenidae. The members of this group possess two or four limbs, and in the Sirens only two—the front-limbs—are present. Four toes exist on these limbs. The body is of cylindrical shape. The external gill-tufts number three on each side, and are of plumose shape. The colour of the familiar species (*Siren lacertina*) is a dark-brown, and the average length is about 3 feet. The head is small, and numerous teeth are developed. These animals, of which at least three species are known, inhabit North America exclusively. The common species above noted is found inhabiting the rice-swamps of South Carolina. It prefers damp muddy situations, and feeds upon the worms and insects which it finds in the mud. A domesticated specimen fed eagerly on earth-worms. A delicate fringe of skin answers the purpose of dorsal and tail fins, and surrounds the hinder margin of the body. Dr. Garden, the original discoverer of this animal, who gave Linnaeus specimens for description, told wonderful stories of its powers of voice and song—these absurd reports leading Linnaeus to name the genus *Siren*, after the famed mythological singers.

**SIREN**, an instrument invented by Cagniard Latour for counting the vibrations producing a given note. The siren consists of a bellows connected with a cylindrical chamber having in its top a number of equidistant holes arranged in a circle; a circular plate having corresponding holes lies exactly on the chamber top, and this plate is capable of turning freely with



its arbor or axle. The accompanying figures do not exhibit the bellows of the instrument; they exhibit the sloping directions of the holes, and an inside view of the gearing of the counting arrangement; the two little knobs, one at each side, are for putting the screw on the arbor out of or into gear with the wheels instantaneously. Suppose that the holes in the plate are exactly opposite those on the chamber top; air from the bellows will issue from all the holes at once, but by reason of their skew directions the plate will revolve, and thus cut off the air; air will again issue when the plate has turned a distance equal to the space between two holes, and in a complete revolution the air will have puffed momentarily through the holes of the upper plate as many times as there are holes in the chamber top. If the pressure of air be increased till the motion is rapid enough these puffs will become a musical note, of which the pitch may be estimated from the number of revolutions made by the plate in a given time. No inconvenience except a waste of air arises from the plate not fitting very tightly against the chamber top. The siren will sound under water, if water is driven through it instead of air, hence its name. It may be observed that one hole in the revolving plate would give the same note as the twenty holes, but this note would not be so loud. Various arrangements of holes are sometimes supplied with the machine, so that it will sound two or three different notes at once, &c. To produce a constant note with the siren for some seconds it is necessary to maintain the pressure of air constant for that time. Savart's wheel is an instrument for the same purpose as the siren, and in that instrument it is necessary to turn the wheel at a constant rate during the time of observation. See SAVART'S WHEEL.

**SIRENIA**, an order of Mammalia, formerly ranked as a sub-order of the Cetacea or Whales, but separated from the latter on account of obvious differences in structure as well as in habits. To the Sirenia, which are allied to the Ungulate or Hoofed

Quadrupeds, belong the Manatees (which see) or Sea Cows, the Dugongs, and the now extinct *Rhytina* (which see). These animals inhabit the shallow waters of coasts and the estuaries of rivers. The body is somewhat fish-like in appearance, and adapted for an aquatic life. A caudal or tail fin exists, but this is set horizontally as in Whales, &c., and not vertically as in fishes. It is, moreover, a mere

expansion of the integument or skin, and is not supported by fin-rays as in the latter forms. No hind-limbs or sacrum are developed, and the fore-limbs exist in the form of swimming-paddles or 'flippers', and constitute the chief means of progression. The nostrils are placed on the upper aspect of the well-developed snout; and fleshy lips, the upper generally 'moustached', are present. Two sets of teeth are developed; the permanent set comprising molars with flat crowns and otherwise adapted for a vegetable dietary. Incisor teeth are developed in the young animals, but fall out or are absorbed as the adult state is attained. In *Rhytina* the incisors were probably wholly undeveloped. No hair exists, but a few bristles are scattered over the trunk. The head, although of large size, does not yet contrast so markedly with the body as in the Whales; and although a distinct neck is undeveloped, yet the

head and body do not merge so insensibly into each other as in the Cetacea. No collar-bones or clavicles are developed. The fingers are composed of not more than three joints (or phalanges) each. The testes number two, and the mammary glands are *pectoral* in position—that is, placed on the chest. The testes are abdominal throughout life, but seminal vesicles are also developed. The uterus is cleft superiorly into two cornua or 'horns'. The placentation or form of placenta is unknown. In their permanent dentition the Manatees show two small upper incisors (in the young state), and sixteen permanent molars in each jaw. The Dugongs have ten molars in each jaw when young, but these dwindle down to four in each jaw in the old animals. Lower incisors exist in the young Dugong, and fall out as in the Manatees, and the upper jaw in the Dugongs carries two incisors, which are tusk-like in the old males, but hidden by the gums in the females.

No dorsal or back fins are ever present in Sirenia, these appendages being developed in several Cetaceans. The chief structural peculiarities consist in the presence of only six cervical or neck vertebrae in the Manatees—seven being the usual number in that region of the Mammalian spine. The stomach exhibits a tendency towards a compound nature, and is divided into two portions by a constriction in the middle, and a gland, the function of which is unknown, exists at the cardiac or anterior extremity of the stomach. In some cases its pyloric or hinder extremity gives off two caeca or blind sacs. A caecum exists at the junction of the small with the large intestine. The heart is deeply cleft at its apex, so that it presents a double appearance. Salivary glands are developed. The diaphragm or 'midriff' extends in an oblique manner from before backwards, and the cavity of the chest in consequence extends posteriorly over the greater part of the abdominal cavity. The food consists of vegetable matters, such as may be obtained from the vegetation of shores and rivers.

The three genera already mentioned (*Manatus*, *Halicornis*, and the recently extinct *Rhytina*) represent this interesting order of Mammalia. The Manatees inhabit the Atlantic shores of Africa and South America; the Dugongs are found on the coasts of the Indian Ocean and on those of Australia; whilst the Rhytina inhabited Behring's Straits. An extinct genus of Sirenians, *Halitherium*, occurs in Eocene, Miocene, and Pliocene formations. This latter form was of large size, and appears to have been somewhat intermediate in structure between the two living genera—or more especially between the *Manatus Africanus* of Africa and the Dugong. *Halitherium* also appears to have possessed rudimentary hind-limbs.

It may lastly be mentioned that the name 'Sirenia', applied to this order, is derived from the supposition that these forms, which possess the power of sitting up in a semi-erect posture in the water, may have given rise to the stories of 'Mermaids' and 'Sirens,' which sailors are so fond of relating. The position of the mammae on the chest might also, at a distance, increase the resemblance of these animals to the human form.

SIRENS, inferior goddesses, who, by their singing, fascinated those that sailed by their island, and then destroyed them. Homer represents them as young women, without informing us of their number or origin. Later poets give different accounts of their persons, number, names, and places of residence, and describe them as daughters of the Æolian river god Achelous by Sterope, daughter of Amythaon, or of Melpomene, of Terpsichore, or of Calliope, and sometimes as having sprung from the blood which flowed to the earth from the horn of Achelous, broken in his struggle with Hercules. Euripides, in reference to the latter account, calls them the daughters of the Earth. Sophocles calls them daughters of Phorcus; and this is, perhaps, the oldest account. The author of the Orphic Argonautics places them on a projecting rock on the shore near Ætna, alluring the Argonauts by their fatal singing. But Orpheus sang a heroic song to his lute, and the Sirens, finding themselves vanquished in singing, flung away their flutes and lyres and threw themselves into the sea, where they became formidable rocks. According to Homer the island of the Sirens was situated between Ætina and the rock of Scylla, near the south-western shores of Italy. When Ulysses approached their island the Sirens were sitting upon the beach, and strove to allure him and his companions; but Ulysses took the precaution of stuffing the ears of his companions with wax, while he bound himself to the mast, and so they escaped. Plato invents eight Sirens, who are borne round on the eight heavenly circles, and who make the music of the spheres, which others attribute to the nine Muses. There is likewise a story of their trial of skill in singing with the Muses. The latter were victorious, and plucking the feathers from the wings of the Sirens made garlands of them. These wings the Sirens are said to have received at their own request, in order to be able to search for Proserpine; while another account makes them out to have been given as a punishment from Demeter for not having assisted Proserpine.

SIRINAGUR. See SRINAGAR.

SIRIUS, the star α in the constellation Canis Major. Sirius is a white star, and is the brightest star in the heavens. Seneca described it as red, the colour of Mars; and Ptolemy described it as of the same colour as Antares, which is now a noted red star.

SIROCCO, a hot, relaxing, and oppressive south-east wind, which blows in Sicily and South Italy.

While it continues the atmosphere is obscured by a haze, and so great is the languor it occasions that few persons quit their houses. It is supposed to be the same as the simoom, tempered by its passage across the water.

SISKIN (*Fringilla spinus*), a species of Insectivorous Birds, included in the sub-order Conirostræ, and in the family Fringillidæ. It is sometimes also known by the name Aberdevine. This bird is coloured of a general green, particularly on the back and upper parts. Each feather on the back is coloured dark green in its centre. Yellow hues tint the plumage on the neck, breast, and behind the ear; and similar tints varying in intensity are seen on the wing-coverts and tail. The quills of the tail and wings are coloured black in the middle, this latter tint sometimes shading into olive. The belly and under tail-coverts are white, the inner aspects of the legs being gray. The average length of the Siskin is about 5 or 5½ inches. These birds are usually seen in small flocks, haunting the margins of streams, and feeding on the seeds of rushes, elder-trees, and other plants. They are active and lively in all their movements, and climb among the twigs and boughs of trees with great facility. The eggs three to five in number, are deposited in a nest built usually in the fork of a branch, and constructed of moss, grasses, feathers, and similar materials. The Siskin inhabits Britain, and appears to perform a migration, the extent of which is undetermined. Some appear to fly to Norway and Sweden in summer, and pair there, returning to Britain in winter. These birds are much sought after by birdcatchers, and the Siskin and Canary, when interbred, produce a hybrid progeny with a sweet mellow song.

SISMONDI, JEAN CHARLES LEONARD SIMONIDE DI, a celebrated historian and political economist, the son of a Protestant minister near Geneva, was born there in 1773. His family was originally from Pisa, from which it had emigrated into Dauphiné, and afterwards, in consequence of the Edict of Nantes, removed to Geneva. In his early life he suffered much from the storms of the French revolution. He had scarcely completed a careful education at the College and the Auditoire of Geneva when the overthrow of the constitution of his native town obliged him to flee with his father to England. On his return, two years after, he was imprisoned, and lost the greater part of his property by confiscation. Similar persecution followed him even in Tuscany, whither he proceeded in 1795, and where he was hated by the French as an aristocrat, and by the Italians as a Frenchman; but at length, on his return to Geneva in 1800, he was allowed to live in quietness and devote himself with the utmost diligence to literary pursuits without declining to bear his part in the discharge of municipal functions. His first published work appeared in 1801, and was entitled *Tableau de l'Agriculture Toscane*. It discards all appearance of theory, and abounds in practical details. In 1803 he published a work entitled *De la Richesse Commerciale, ou Principes d'Economie Politique appliqués à la Législation du Commerce*. This essay was afterwards remodelled so as to form the groundwork of his treatise published in 1819 under the title of *Nouveaux Principes d'Economie Politique*. He had become intimate with Madame de Staël, and in 1805 accompanied her on a tour through Italy. The associations thus awakened appear to have called his attention particularly to history. The first-fruits of his labours in this department appeared in 1807, in the first two volumes of his *Républiques Italiennes*, which ultimately reached sixteen volumes, and was not completed till 1818. It is written in a pleasant and attractive style,

with great fidelity and very impartially, but fails to give a profound and philosophical development of the origin and progress of the constitutions of the different republics. While engaged with this work Sismondi contributed largely to Michaud's *Biographie Universelle*, and also published a course of lectures which he had delivered in Geneva in 1811. This work, entitled *De la Littérature du Midi de l'Europe*, is chiefly derived from secondary sources. In 1819 he married Miss Allen, sister to the second wife of Sir James Mackintosh, and the same year commenced his *Histoire des Français*, a great work which was to occupy the greater part of his remaining life. It was carried to thirty-one volumes, though reaching no further than 1750. According to some it is his best production, while others consider it as little better than a laborious compilation. In 1830 he abridged his *Républiques Italiennes* for Lardner's *Cabinet Cyclopædia*. This abridgment, published in French in 1832, under the title of *Histoire de la Renaissance de la Liberté en Italie*, has proved perhaps the most popular of all his writings. One of the last and least known is his *Histoire de la Chûte de l'Empire Romain et du Déclin de la Civilisation de 250 à 1000*. In 1840 he felt the first symptoms of cancer in the stomach, which carried him off, after two years of great suffering, in 1842.

**SISTERS OF CHARITY.** See **FRATERNITIES**.

**SISTINE CHAPEL** (*Capella Sistina*), a chapel in the Vatican, so called from Pope Sixtus IV., by whom it was erected in 1473. It was destined for the religious services performed during Passion Week, for which it is still chiefly used. It is 132 feet long by 45 feet wide, has sixteen windows on each side above, and beautifully decorated marble screens inclose the space set apart for religious solemnities. The lower part was formerly, on festive occasions, hung with Raphael's tapestry; the upper part, with the exception of the wall of the altar, is decorated with interesting frescoes by Florentine masters of the fifteenth century. The whole of the wall behind the altar is covered by Michael Angelo's picture of the Last Judgment—a great poem in itself. On the vaulted ceiling the same master has painted the creation of the world, and around it prophets and sibyls. The other walls contain, in twelve compartments, the productions of Signorelli, Filippi, Perugino, Roselli, &c.

**SISTOVA**, or **SCHISTAB**, a town of the Principality of Bulgaria, 35 miles south-west of Rustchuk, on a height above the right bank of the Danube, here capable of floating vessels of 500 tons. It is surrounded by a palisaded fosse, and defended by a castle; is poorly built, but has several mosques, a Greek church, and an active trade chiefly in leather and cotton. It was taken and dismantled by the Russians in 1810. Pop. (1893), 13,312.

**SISYPHUS**, a mythical King of Corinth (which, according to some, he built), son of Æolus and Enarete. He married Merope, the daughter of Atlas. In later accounts he is represented as the son of Autolycus and the father of Ulysses. The Attic poets relate many instances of his art; he promoted navigation and commerce, but was fraudulent, avaricious, and deceitful. Theseus, whose dominions he disturbed, slew him. Some impute his death to Zeus, in revenge for his having informed Æsopos of the rape of his daughter. He is said to have put death in fetters, so that for some time no one died. He afterwards overreached Pluto by getting leave to visit the upper regions, whence he did not return till he had lived out the natural term of his life. In consequence of this he was severely punished in the nether world, being obliged to roll a heavy stone to the top of a hill, on reaching which it would always roll back again, thus rendering his punishment eternal.

**SITKA**, formerly called also New Archangel, the capital of Alaska Territory, situated on the western coast of Baranoff Island. It was the residence of the governor of Russian America prior to its annexation to the United States. It has a small but good harbour, and the inhabitants are largely engaged in catching and curing fish. Pop. (1890), 1188. The Sitka Islands are well supplied with wood, and fish are very abundant.

**SITTINGBOURNE**, a market-town and seaport of England, in Kent, on Milton Creek, a branch of the Swale, and close to the town of Milton. It is a place of great antiquity, and still has important local markets, carries on some shipping trade, has brick and cement works, &c. Pop. in 1901, 8944.

**SIVA** (Sanskrit, 'happy', 'auspicious'), the name of the third deity in the Hindu triad, in which he is represented as the destroyer of creation. He also personifies reproduction, as Hindu philosophy excludes the idea of total annihilation without subsequent regeneration. Siva is the particular god of the Tantrikas, whose sacred books are the Tantras. His worshippers are termed *saivas*, and assign to him the first place in the Trimurti or triad, attributing to him also many attributes which properly belong to the other deities. According to the *saivas* Siva is Time, Justice, Water, the Sun, the Destroyer, and the Creator. His symbol is the *lingam* or *phallus*, emblematic of creation. He is represented in his characters of the god of regeneration and of justice as riding on a white bull. He has five heads; three eyes—one on his forehead, indicative of his power of contemplation; two, four, eight, or ten hands; and in the middle of his forehead a crescent. His throat is dark blue; his hair of a light reddish colour, thickly matted together, and brought over his head so as to project like a horn from his forehead. He wears a garland of human skulls round his neck, and as a second necklace a serpent; and in his hand holds a trident, surmounted by a skull and one or two human heads. He is often represented as entirely covered with serpents, which are the emblems of immortality. His weapons are the *Kinkhira*, of which nothing is known, a bow called *Ajakra*, a thunderbolt, and an axe. He resides on the wonderful Mount Kailâsa, the northern peak of the Himalaya. One of his principal attendants is Tandû, a teacher of the arts of dancing and mimicry, whence Siva is the patron of dancers. Siva has more than a thousand names, which are detailed at length in the sixty-ninth chapter of the *Siva-Purana*. These names are mostly all derived from his attributes and character. Among the exploits of Siva is recorded his having cut off, in a fit of anger, one of the five heads of Brahma. He likewise beheaded his father-in-law, Daksha, for having offended his wife; but on the interference of the gods he placed a ram's head on the headless trunk.

**SIVACH**, **GHILOE-MORE**, or **PUTRID SEA**, Russia, an arm of the Sea of Azof, on the north-east side of the Crimea, communicating with the sea by a narrow entrance on the north, and separated from it by a long and narrow belt of land. It has a length of about 110 miles, with a breadth varying from 2 miles to 15 miles; is indented by numerous small bays, and contains several small islands, with precipitous cliffs.

**SIVAS** (anciently *Sebaste*), a town in Asiatic Turkey, capital of a pashalic of the same name, sometimes also called Roum, near the centre of a large and fertile plain, 410 miles E.S.E. of Constantinople. It covers a large space, much of which is occupied by ruins, and has about 5000 Turkish and 1000 Armenian houses, arranged in narrow, winding streets. Its chief edifices are two castles situated

on commanding heights; numerous mosques, many of them handsome structures, with elegant porches and minarets; large and well-supplied bazaars, commodious khans, baths, &c. Being on the best road from Bagdad through Diarbekir and Malatiyeh, and having easy access to the Black Sea, it commands a considerable trade. Lucullus here gained a signal victory over Mithridates; and Tamerlane, after fighting several battles with Bajazet, made him his prisoner. Pop. about 43,000. The pashalic has a population of about 800,000.

**SIVATHERIUM**, an extinct genus of Ungulate Mammalia, the fossil remains of which occur in the Pliocene Tertiary deposits of the Siwalik Hills in Hindustan. They were discovered by Dr. Falconer and Sir Proby Cautley. A single species (*S. giganteum*) only has been determined. This form has usually been referred to the family Antilopidae or Antelopes (Ruminantia); but by some authorities, such as Dr. Murie, a distinct family (Sivatheridae) is constituted for the reception of the Sivatherium; and in this view the new family would appear to be most nearly related to the existing Antilocapridæ or that of the Prongbuck (which see). Sivatherium was of very large size, and exceeded all living antelopes in bulk. The characteristic feature of this form consisted in its apparently possessing two pairs of horns, supported on bony cores, as in living antelopes, sheep, &c. The front pair of horns were of simple form, whilst the larger hinder pair were branched, and possessed two 'snags'—this latter feature being found in no existing antelope except the Prongbuck. Murie has suggested that the Sivatherium, like the existing Prongbuck, may have shed the *sheaths* of its horns annually; and this theory may account for the fact that the horn-sheaths have never yet been found in a fossil condition. The extinct form known as Bramatherium is of the same age as the Sivatherium. It is nearly allied to the latter, and also possessed four horns.

**SIWAH**, or **AMMON**, an oasis in Egypt, 320 miles w.s.w. of Cairo, lat. 29° N.; lon. 26° E.; 6 miles long by 5 miles broad. It consists of an eastern and a western district, the former abounding in date-trees, yielding fruit of very superior quality. The inhabitants are hospitable, but suspicious and savage. The principal town, Siwah, is divided into an upper and lower district; is defended by a citadel, and surrounded by strong walls. Married people alone are allowed to inhabit the upper town, and there no strangers are admitted. Bachelors are compelled to live in the lower town. The principal commerce and source of revenue is derived from dates. The people have few manufactures beyond those things required for their own use; their skill, however, in making wicker-baskets is remarkable. About 3 miles west of the town of Siwah are the ruins of the temple of Jupiter Ammon, now called Om-Baydah (mother white), near what is supposed to be the Fountain of the Sun. The ruins are not very extensive. Many of the sculptures, including figures of Ammon, with the attributes of the ram-headed god, and of other divinities, still remain. Pop. 3750.

**SIX ARTICLES**, **STATUTE OF**, a law made by 31 Henry VIII. cap. xiv., and styled An Act for Abolishing Diversity of Opinions. It was passed on June 7th, 1541, and came to be commonly known as the *bloody statute*. The preamble states that 'the king hoped that a full and perfect resolution of the said articles should make a perfect concord and unity amongst all his subjects.' The articles that were to bring about this happy state of concord were as follows:—It was enacted that if any one, by word, writing, or otherwise, did teach, preach, or hold opinions against the real presence, he should suffer death

as a heretic by burning, and forfeit as in case of high-treason; and that if any one preached, taught, or obstinately affirmed or defended that the communion in both kinds was necessary, or that priests might marry, or vows of chastity be broken, or private masses not used, or that auricular confession was not expedient, it should be felony. These points were declared to have been 'determined and resolved by the most godly study, pain, and travail of his majesty; for which his most humble and obedient subjects, the lords spiritual and temporal, and the commons, in Parliament assembled, did render and give unto his highness their most high and hearty thanks.' The act was at first vigorously enforced; but after undergoing some mitigation in 1544, it was finally repealed in 1549.

**SIXTUS V.**, one of the ablest and most vigorous occupants of the Papal chair, was born in 1521 near Montalto, in northern Italy. His proper name was Felix Peretti. So poor were his parents that his boyhood was spent in the humble occupation of a swineherd; but, giving early indications of an aspiring disposition, he was rescued from this mode of life by a Franciscan father, through whose influence he was admitted in 1534 into the order, when he received the usual strict education and instruction of the monasteries. His active spirit soon made him conversant with the scholastic philosophy and theology and Latin literature. In 1544 he gave instruction in the canon law at Rimini, and in 1546 at Siena. In 1548 he was made priest, doctor of divinity, and superintendent of the monastic school of Siena. In 1556 he removed to Venice, where he was appointed superintendent of the Franciscan school, and afterwards inquisitor-general. The severity he displayed in the discharge of his official duties, combined with his domineering manner, created for him a number of enemies in that city. In 1560 he quitted Venice and proceeded to Rome, where the pope conferred upon him several dignities. Some years later (1565) he attended the Papal legate to Spain as the theologian of the embassy, and while here he acquainted himself with the policy of the Spanish court. In 1570 the dignity of cardinal was conferred upon him by Pius V. The great object of his ambition being the Papal chair, he thought the best way to attain it was to withdraw himself as much as possible from the court, and devote himself entirely to spiritual concerns. Till then violent, ambitious, active, and strong in body, he now assumed the very opposite of those qualities, and under the mask of pious simplicity and feeble old age prepared himself for the first place in the Roman hierarchy. If we believe his chroniclers, who, however, were generally inimical to him, it would appear that it was to the characteristics he now manifested that his election to the Papal see in 1585 were principally due; and the story is told that immediately after the election he threw down in the electoral chapel the staff on which he had hitherto leaned, and came forward, to the astonishment of all the cardinals, in the full vigour of his physical strength and his moral character. Whatever faith may be attached to the account given of the way in which he reached the goal of his ambition, certain it is that when there he manifested himself an able and energetic ruler. During his five years' administration he devoted himself with great vigour to the reform of abuses both civil and ecclesiastical. Under his immediate predecessors, Pius V. and Gregory XIII., the civil disorder was excessive in the States of the Church, crimes had gone unpunished, and hordes of brigands infested the whole country. All this was now remedied, stern justice was administered on all hands, the country was cleared of robbers, and under

the security thus produced, agriculture, commerce, and industry flourished anew. Among other works which testify to the usefulness of his administration he founded a new university at Fermo, and new colleges at Rome and Bologna; he embellished Rome with numerous and useful structures, among others the present building of the Vatican Library. He published a new edition of the Septuagint in 1587, and one of the Vulgate, with improvements, in 1590, besides corrected editions of the Church Fathers. He displayed the same energy in the spiritual administration of the church, re-established discipline in the religious orders, and founded or reformed several congregations of cardinals and other officers. He fixed the number of cardinals at seventy. Outside of his own states he took a part in most of the great events that then agitated Europe. He avoided war with the Christian princes as much as possible, though he encouraged and supported Henry III. against the Huguenots, Philip II. against England, and Archduke Maximilian when he was a candidate for the Polish crown. The great aim of his foreign policy was the promotion of the cause of Roman Catholicism throughout all christendom against Protestantism. Sixtus died in August, 1589. His life has been written by Leti, Tempesti, Rolardi, Dummenil, Hübner, and others.

**SIZAR**, a term used in the University of Cambridge, and at Trinity College, Dublin, to denote a class of students who are pecuniarily assisted through the benefactions of founders or other charitable persons. They were originally required to perform certain duties of a menial character, but this practice has long ago fallen into desuetude. Sizars, not being on the foundation, are not eligible for fellowships, but they may become pensioners, and also sit for scholarships, the possession of which places them on the foundation, and thus opens the way to a fellowship. The name is supposed to be derived from *siz*, which in college phraseology denotes an allowance of victuals from the buttery. A corresponding class of students in Oxford were called servitors.

**SIZE**. See **GLUE**.

**SKAGEN, CAPE, or THE SKAW**, the extreme point of the tongue of land which forms the northerly portion of the province of Jutland, Denmark. An important lighthouse, 67 feet high, built by Frederick II. in 1564, is situated on the cape. The village of Skagen, close by, has 1400 inhabitants.

**SKAGER-RACK**, a broad arm of the German Ocean, which washes Norway on the north, Jutland on the south, and Sweden on the east, where it communicates with the Cattegat; length, w.s.v. to E.N.E., about 150 miles; breadth, 80 miles. It is shallowest off the coast of Jutland, where its depth varies from 30 to 40 fathoms; near the centre it is from 60 to 100; off some parts of the Norwegian coast it exceeds 200. On the Danish coast there is not a good harbour in this sea, but both Norway and Sweden have several.

**SKALDS**. See **SCALDS**.

**SKALITZ, or SZAKOLCZA**, a royal free town of Hungary, on the left bank of the March, near the confines of Moravia, 47 miles north of Pressburg, on a lofty height, surrounded by walls, and nearly in the form of a square. It has considerable manufactures of cloth. The district is famous for its fruit, and produces good wine. Pop. (1890), 4926.

**SKATE**, a species of Elasmobranchiate Fishes, commonly included among the Rays (which see). The Common Skate—the *Raja batis* of the naturalist—agrees with the other members of the genus *Raja* in possessing a flat, broad body, the chief portion of which is made up of the expanded pectoral fins, which are concealed, in a manner, under the skin. The

tail is of slender conformation. The snout is pointed, and possesses a prominent ridge or keel. The teeth are arranged in a mosaic or pavement-like pattern, and the teeth of the males become pointed during the breeding season. This fish, although commonly seen of moderate dimensions, may attain a weight of 200 lbs. or more. The females are termed 'maids' by the fishermen, and the male, which has two appendages or 'claspers' situated at the base of the tail, is sometimes named the 'Three-tailed Skate or Ray.' These fishes are very voracious, and devour all kinds of crustaceans as well as smaller fishes. See also **PLAGIOTOMI, RAYS, &c.**

**SKATES AND SKATING**. A skate consists of a frame shaped somewhat like the sole of a shoe, underneath which is fastened a metallic runner, the whole being intended to be fastened, one under each foot, for sliding or travelling over the ice. Skating seems to be of great antiquity; mention is made of it in the Edda, in which the god Uller is represented as distinguished by his beauty, arrows, and skates. Both in Edinburgh and in London skating was a highly popular amusement several centuries ago, and in no other country has it been carried to such a high degree of perfection as it has in Great Britain, except perhaps in Canada, where they have covered-in skating 'rinks.' William Hone, in the Every Day Book, remarks that 'the elegance of skaters on the Serpentine is chiefly exhibited in quadrilles, which some parties go through with a beauty scarcely imaginable by those who have not seen graceful skating.' In Holland, from time immemorial, skates have been used by all classes of people upon the canals and rivers for the facility of locomotion they afford. In countries where snow abounds skating cannot be practised with such facility as in some other countries where this is not the case, and this is assigned as the probable reason why the amusement has not been so general, or carried to so great perfection, in the United States as in some parts of Europe. In that country, however, as well as in Britain, the amusement is becoming in the highest degree fashionable, and is as much appreciated and practised by the fair as by the ruder sex. Great varieties in the manufacture of skates have been introduced within a comparatively short period. It would be needless here to enumerate these, but it may be stated generally that in the most improved forms the wood of the older skate has been replaced by metallic fittings, and the skate is attached to the foot by spring fastenings, which obviate the need for straps. A certain kind of skates, termed 'parlour skates,' in which the metal runner is replaced by small wheels, is used for going along on the ground. They were introduced in Paris in 1819, but their use has not become very general.

**SKELETON**, the name applied specially to the hard structures, mostly of bony or osseous nature, which form the internal axis or support of the soft parts in the higher or Vertebrate animals. The term, however, is used in comparative anatomy to designate hard parts not only of internal, but also of external nature. We thus speak of an *endoskeleton* as proper to the Vertebrata; but both Vertebrates and Invertebrates may have certain hard parts developed on the exterior of their bodies (for example, shell of lobster, scales of fishes, &c.), and to the latter class of structures we apply the name *exoskeleton*. The parts of any endoskeleton may generally be grouped under the two heads of the spinal or *axial* skeleton, and the *appendicular* parts. The former includes the skeleton of the head and trunk, the latter that of the limbs. The spinal skeleton involves the consideration of the *skull*; *spinal* or *vertebral column*, composed of its various *vertebræ*; and of the *thorax* or *chest*,

and *pelvis*. The composition of the skull forms a subject of great intricacy, and involves many highly technical considerations. The more general characters of the skull are noted in the article of that name. The vertebrae or component parts of the spine or backbone consist each of a solid piece or *body*, attached to which are various processes. The spinal arches spring from the posterior part of each vertebra, and unite to form the spinous process; the spinal cord itself being protected within the canal formed by the apposition of the arches of the vertebrae. In man seven cervical or neck vertebrae, twelve dorsal (back), and five lumbar (loins) vertebrae exist as separate bones. The *sacrum* and *coccyx*, forming the terminal part of man's spine, are composed of united vertebrae. (See *SACRUM*.) The *pelvis* is described in the article of that name. The *thorax* or *chest* is formed by the spine posteriorly, by the ribs laterally, and in front by the sternum or breastbone. The ribs of man correspond in number with the dorsal vertebrae. (See *RIB*.) The limbs consist of homologous or corresponding parts, and are attached to a series of bones constituting the 'arch' or support of the fore and hind limbs respectively. The scapulae (which see) or shoulder-blades and collar-bones or *clavicles* constitute the shoulder-girdle or arch supporting the fore or upper limb, whilst the lower limb is attached to the pelvic arch or pelvis. The upper limb consists of the *humerus* or bone of the upper arm; the *radius* and *ulna*, or bones of the forearm; the *carpal* or *wrist bones*; the *metacarpal bones*, or those of the palm; and the *phalanges*, or bones of the fingers. The lower limb consists of the *femur* or thigh-bone; the *tibia* (shin) and *fibula* or bones of the leg; the *tarsal* bones or those of the ankle, corresponding to those of the wrist; the *metatarsus* or instep; and the *phalanges* or bones of the toes. See also such articles as *MAMMALIA*, *ORNITHOLOGY*, &c., for special descriptions of the skeletons of the various groups of animals.

**SKELLIGS**, *THE*, three islands on the south-west coast of Ireland, in the county of Kerry, 8 miles west of Bolus Head; lat. (lights), 51° 46' N.; lon. 10° 32' W. The largest, called the Great Skellig, is an enormous precipitous rock of slate, 710 feet high. A lighthouse has been erected upon it, with a fixed light 175 feet above high water.

**SKELTON, JOHN**, an English poet, born about 1460, probably at Norfolk. He studied at both Oxford and Cambridge, and from both he received the laureateship (then a degree in grammar). He was tutor to the Duke of York, afterwards Henry VIII.; was rector of Diss and curate of Trompington in 1504, and was appointed *orator regius* to Henry VIII. In an epistle dedicated to him by Erasmus, that writer declared him to be the *lumen et decus* of British letters. In the pulpit he was remarkable for his buffoneries, and according to Anthony à Wood he was esteemed 'fitter for the stage than for the pew or pulpit'. There were three objects at which he delighted to aim his satire—the mendicant friars, Lily the grammarian, and Cardinal Wolsey. His attacks on Wolsey at length roused the resentment of that prelate, and an order being issued for his apprehension, he took refuge in the sanctuary at Westminster, where the abbot afforded him protection until his death, June 21, 1529, not long before the fall of Wolsey. His works, consisting of comedies, satires, and short poems, were published in 1512. These comprise among others the drama or morality of *Magnificence*; a satire on Wolsey, entitled *Why come ye not to Court?* the *Tunning* (that is the brewing) of *Elynor Rumnyng*, a humorous picture of low life; and the *Book of Phylip Sparrow*, an elegy on the sparrow belonging to the 'goodly maid'

Jane Scroope, which was killed by a cat. The last is the most poetical of his pieces. He is compared to Rabelais as regards indelicacy and volubility. The best edition of his works is by the Rev. Alexander Dyce (two vols. London, 1843).

**SKERRIES** (*skerries*, a sea-girt rock), a seaport and fishing town, Ireland, in the county and 17 miles N.N.E. of Dublin. It stands on a little headland, and has a clean and cheerful appearance. The main street, which is wide and irregularly built, is nearly 1 mile long. A large proportion of the female population is employed in embroidering. Pop. (1891), 1800.

**SKERRYVORE**. See *LIGHTHOUSES*.

**SKETCHES**. See *DRAWING*.

**SKIEW-BRIDGE**, a species of bridge which, instead of crossing a road or river at right angles to its course (the easiest and most usual method), makes an oblique angle with it, in order that the continuity of the road may be preserved. This is a common kind of bridge on railroads, where it is desirable to have the line as direct as possible. Skew-bridges built of stone are more difficult of construction than the ordinary bridge, the joints requiring to be spiral.

**SKIATHO** (ancient, *Skiaθος*), an island in the Grecian Archipelago, off the south-east coast of Thessaly; greatest length, north to south, 5 miles; greatest breadth, 4 miles. It is finely diversified by wooded hills and fertile plains, often laid out in vineyards and olive-yards. The chief place, called also *Skiatho*, is placed on a steep and lofty rock, accessible only by a wooden bridge. Pop. (1896), 2780.

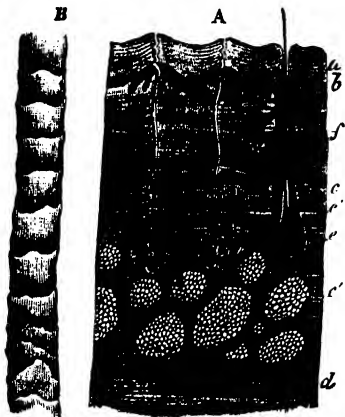
**SKIBBEREEN**, a market-town of Ireland, in the county and 54 miles south-west of Cork, on the left bank of the *Ilen*. The houses are well built of stone. There is a court-house, an Episcopal, a Roman Catholic, and a Methodist church, &c. The *Ilen* is navigable for lighters of 50 tons up to the town. There is a considerable trade in corn and butter, and hand-loom weaving is carried on. Pop. (1881), 3631; (1891), 3269.

**SKIDDAW**, one of the highest mountains of England, in Cumberland, distinguished for its grand and romantic scenery, as well as for the lakes in its different hollows and near its base; height, 3022 feet. It is 3 miles north of Keswick.

**SKIFF**. See *BOAT*.

**SKIN**, the name given to the external layer or tissue of the bodies of most animals, which comprises the parts generally included by comparative anatomists under the name of the *exoskeleton* or *external skeleton*. The 'skin' under this latter denomination includes not only that tissue itself, but all the structures which are developed from or within it. Included in this category we should accordingly find such structures as the nails, hair, enamel of teeth, and many other parts, which, although unrepresented in man, yet form integral parts of the skin-tissues of the lower animals. Structurally viewed, the skin of all Vertebrates consists of two layers—an outer and inner layer. To the outer layer the name of *cuticle*, *epidermis*, or *scarf skin* is popularly given. As is well known this layer is destitute of nerves and of blood-vessels, and is thus a non-sensitive structure. The inner layer is, on the contrary, a highly vascular and sensitive layer, and is named the *dermis*, *corium*, or *true skin*. At the lips and elsewhere the epidermis becomes continuous with the more delicate *mucous membrane* (see *MEMBRANE*), which forms the lining membrane of the internal passages. This membrane is to be viewed, however, as a mere modification of the epidermis itself. The names *ecteron* and *enderon* are frequently applied in comparative anatomy to the epidermis and dermis respectively. The structure of the epidermis shows it to be composed of several layers of cells of *squamous* or *pavement epithelium*. The upper cells of the

epidermis, as seen in a vertical section of the skin, are flattened, and of scaly conformation, the lower cells being of rounded or elongated shape. The elong-



A. Section of skin under the microscope. *a, b*, Superficial and deep layers of epidermis. *c*, Dermis—true skin. *c'*, Fatty areas of the deeper portions of the dermis. *d*, Muscular layer subjacent to the skin. *e, e'*, Sweat glands and ducts. *f*, Hair-follicle and sebaceous gland. B. Hair seen under the microscope.

gated cells have their long axes arranged vertically to the general skin surface. The deeper portion of the epidermis receives the name of *rete mucosum*. This latter layer is of softer and more opaque consistence and appearance than the upper layer; and it is chiefly in the cells of the rete mucosum that deposits of pigment, determining the colour of the skin, take place. The upper layers of cells may also contain pigment, but never in such quantities as those of the rete mucosum. The growth of the epidermal layer of the skin is carried on from below, the deeper cells being gradually pushed upwards to take the place of the upper ones as the latter are worn away during life by friction and by ablation. The epidermis is thickest on those surfaces which are most exposed to friction or pressure. The soles of the feet and palms of the hands exemplify this fact; whilst in other situations (for example, inner aspects of the thighs) the upper skin is of very delicate texture.

The *dermis* or true skin exists as a tissue composed of interlacing fibres of fibro-cellular tissue, and thus exhibiting numerous areolæ or spaces in its structure. In the deeper layers of the dermis these spaces or areolæ contain fat, whilst superiorly, or in the upper layers, they may be very small or may be entirely obliterated. The dermis itself lies upon the deeper cellular and adipose tissues of the body. Its surface is highly sensitive, the tactile sense or that of touch residing especially in the *papillæ* with which it is provided. The terminations of sensitive nerve fibres are also abundantly distributed to the dermis. Each papilla is simply a conical projection of the surface of the dermis. The extremity or free point may be simple or divided. The papillæ occur most abundantly on the soles of the feet and palms of the hands, and are therein disposed in curved parallel lines. In other regions of the body the papillæ are not so thickly distributed, and being less functionally active they are in these other portions of less size than in the hands and feet. The average size of a papilla is about  $\frac{1}{10}$ th inch in length and  $\frac{1}{10}$ th inch in diameter at the base. Each papilla receives an abundant blood-supply from capillary loops; and through this vascular arrangement the papillæ may under stimulation

become slightly erectile, and so adapted for the more efficient performance of their functions as tactile organs. The mode in which the sensory nerve fibres end in the papillæ, as mentioned in the article NERVOUS SYSTEM, has not been clearly traced. The bodies named *touch-corpuscles*, which are found within the papillæ, have been supposed to be intimately related to the terminal fibres of the sensory nerves in the skin, whilst the *end-bulbs* of Krause found in the lips, tongue, palate, and elsewhere, have also been credited with a like relation to the terminations of the nerves. The papillæ, as will be understood, are themselves covered by the epithelial layers forming the epidermis, to which latter structure they adhere with a considerable degree of force. The epidermis, at the same time, is thinnest over the papillæ, and becomes thick in the spaces intervening between them. And it has been suggested that this arrangement, by presenting detached points of sensitive nature, may serve materially to increase the sensitive properties of the papillæ. In addition to the papillæ, and contained partly within the tissues of the dermis, we find the *sweat* or *sudoriparous glands*, and also the nearly-related *sebaceous glands*, the latter secreting the peculiar fatty matter or sebaceous material.

The general functions of the *skin* may be briefly summed up by stating that it obviously serves as a protective envelope to the deeper tissues, and assists, as just explained, the exercise of the sense of touch. Besides these primary uses the skin becomes also related in a highly important manner to the lungs and kidneys as *excretory organs*, in that it serves to excrete from the body a large quantity of watery vapour, heat, and a small amount of carbonic acid, with traces of other substances. It also acts as an absorbing medium, and conjointly with these latter and the other functions, it serves to regulate the temperature of the body by presenting a large surface for evaporation. The subject of *excretion* by the skin has been fully noted in the article PERSPIRATION. The skin forms thus an important adjunct to the lungs especially, and also to the kidneys, in this excretory work. Whenever the lungs become enfeebled through disease or from any other cause, the skin takes upon itself a large share of their work. And when the function of the kidneys becomes in any way deteriorated or altered, the skin appears to aid in the excretion of the renal discharge—a circumstance proved by the fact that *urea* (see KIDNEY and URINE) appears in greater quantity in the skin-secretions than at other times. Analyzed to their ultimate anatomical constituents or parts, the skin, lungs, and kidneys evince a close similarity in fundamental plan or type. All three evince the essential structure, more or less complicated, of a membrane destined for the work of separating the blood on the one hand from the atmosphere on the other. In each case water, carbonic acid, and urea pass out in varying proportions. Water exists in greatest quantity in the excretions of the three organs; and solids prevail next in order in the kidneys; whilst a preponderance of gases obtains in the case of the lungs. The skin may be said to unite in a manner the functions of the lungs and kidneys, in that whilst its excretion is essentially of similar nature to that of the kidneys, it absorbs oxygen, and exhales carbonic acid and water like the lungs. If anything the skin and kidneys stand in closer relation to each other than the skin and lungs. The interdependence between the skin and kidneys is well seen in summer and in winter, the skin excreting most freely in hot weather, whilst the kidney excretions diminish; and in cold weather the reverse is the case. Medicines which act upon the skin (diaphoretics) similarly influence the kidneys; and diuretics or medicines which increase the secre-

tion of urine generally influence the skin also in greater or less degree. The question of *absorption* by the skin has already been incidentally alluded to. This point is of some interest, and is further one on all the relations of which physiologists are by no means agreed. The skin undoubtedly absorbs many substances which may be directly or indirectly applied to it. Thus if mercury be rubbed into the skin the characteristic effects of that drug in producing *mercurialism* or *salivation* are induced in the system. Antimonial inunction and arsenic applied directly to the skin surfaces respectively produce their characteristic effects of vomiting and poisoning. Inunction or rubbing the substance *into* the skin appears necessary for the production of the effects mentioned. When substances are merely left in contact with the skin, and especially in a fluid state, it is regarded by some as doubtful if true absorption can occur. The question of the absorption or non-absorption of water by the skin has thus been greatly debated by physiologists. In the lower animals at least water has been proved to be absorbed by the skin (Milne Edwards); and Madden's experiments seem to prove that absorption by man's integument actually occurs. Shipwrecked sailors assuage their thirst by wrapping their bodies in wet clothes; but this result may be due rather to the prevention of evaporation than to absorption by the skin.

In the lower animals, and in the domain of the comparative anatomist, the consideration of the skin and integumentary layers presents phases of widely different aspect from that which they offer to the purely human anatomist and physiologist. Extensions of skin, as between the toes of ducks, &c., or between the arms and legs of flying squirrels, and as seen in bats (see *PATAGIUM*), may exist. And pendulous skin-folds, constituting the 'dewlap' of oxen, &c., and seen also in the rhinoceros, may be observed in particular regions of the body. Some forms (such as the globe-fishes or *diodons*, &c.) possess the power of inflating their integument to a considerable extent with air. Certain hard structures appertaining to the skin, and wholly unrepresented in man, may be found in the lower animals. Horns (seen only in cases of disease in man) are examples of such structures, and consist essentially of hardened and modified epithelial cells. Local thickenings of the skin exist in some animals, as seen in the callouses on the nates of monkeys or on the inner aspects of the limbs of horses, &c. The entire epidermal skin may be periodically shed or exuviated, as seen in many serpents, in efts or newts, and in other lower Vertebrata. In the tortoises and turtles the epidermic exoskeleton attains a high degree of development, and constitutes the horny plates (known as 'tortoise-shell' in one species of turtle) covering the true or inner skeleton of these forms. The dermis or true skin may exhibit a similar development of hard parts in its substance. The *scutes* or bony plates seen in the armadillos are dermal structures united to horny plates formed by the epidermis. In many reptiles and in some lizards the two layers of the skin similarly participate in forming the exoskeleton. The scales of fishes are formed by the dermis or true skin; but those of serpents are epidermic in their nature.

**SKINK** (*Scincus*), a genus of Lacertilia or Lizards, belonging to the family Scincidae, of which it forms the typical representative. To this family numerous genera belong, and these all agree in possessing a distinct conical head, with well developed eyelids. The head is covered with horny *scuta* or large scales, and the nostrils are guarded by scales. No inguinal or thigh pores exist in this family, and in some genera the limbs may be hidden beneath the skin. In the genus *Scincus* itself the scales are of thin and smooth

texture, and the tail is rounded and tapers, being unprovided with spines. The body is somewhat spindle-shaped, and is flat below. Five toes exist on each foot, and the toes are of flattened shape and fringed on the sides. The palate is grooved longitudinally, and is provided with teeth. The ears are of small size, and present serrations in front. The Common Skink (*Scincus officinalis*) occurs in North Africa, and is also found, although not so plentifully, in India. It inhabits sandy places, and when alarmed appears to seek refuge by burrowing swiftly beneath the sand. Its specific name is derived from the fact that formerly it was thought to possess valuable medicinal properties, and the skink accordingly formed no unimportant adjunct to the pharmacopoeias of bygone days; whilst among savage tribes it was and still is regarded as an antidote to the most powerful poisons. In classic ages its virtues were much reputed, and the head and feet of these Lizards were imported to Rome in large quantities preserved in white wine. In modern Egypt the Skink still maintains its reputation for effecting marvellous cures. Its colour is reddish, marked above with cross bands of darker hue, whilst below it is of a white colour, tinged with silvery lustre. Sometimes specimens occur coloured yellowish or light-gray above, and variously spotted. The average length is from 6 to 7 inches. (See *REPTILIA*, Pl. II., fig. 6.)

**SKIPTON**, a market-town in England, in the county of York (West Riding), beautifully situated in a valley near the river Aire, 39 miles west of York. It has an ancient church, places of worship for various dissenting bodies, a well-endowed grammar-school, several minor charities, a mechanics' institute with library and news-room, Turkish baths, &c. Cotton and woollen articles are manufactured, and there is an ale and porter brewery. A considerable market for corn and cattle is held weekly, and there is a brisk general trade, which is much facilitated by the Midland Railway and the Leeds and Liverpool Canal. The ancient and still tenanted castle of Skipton is a spacious quadrangular structure, the greater part of which was erected in the reign of Edward II. The vale of Skipton is exceedingly fertile, and contains some of the best meadows in England. Pop. in 1891, 10,376; in 1901, 11,986.

**SKIRMISHERS**, troops serving in loose order in front of an army. They are arranged in files of two men each, a front and a rear man, and the files are usually separated by intervals of about six paces. Their usual employment is to protect an advancing army from a surprise. When attacked by cavalry the nearest files rush together, and form squares called rally-squares.

**SKIRRET** (*Sium Sisarum*), a plant belonging to the natural order Umbelliferae, sometimes cultivated in kitchen-gardens for its roots. It is a perennial plant, a native of China and Japan. The roots are composed of several prongs about the thickness of a finger, joined together at the top. They were formerly much esteemed, but the plant is now seldom cultivated. It succeeds best in a free, rich, deep soil, and in an open situation. It should be sown in the end of March or in April. The flowers are white, and appear in July and August. The seed ripens in autumn, and the roots arrive at maturity in November.

**SKITTLES**, a favourite game in England, generally played in covered grounds attached to public-houses. It is played with a wooden ball about a foot in diameter, and nine skittles or wooden pins, cigar-shaped and about a foot high. The pins are set up on the ground in three rows of three each, so as to form a square of three pins a side, with one pin in the middle. Each pin is about a foot distant from

the one next it in the same row. The players, standing at a certain distance from the skittles, try each in turn with how few casts of the ball they can knock down all the skittles, how many skittles they can knock down with one cast, or some other such thing.

SKOPELOS, an island of the Archipelago, belonging to the nomarchy of Euboea, situated between Skiathos on the west and Kilidromi on the east, and forming one of the Northern Sporades; greatest length, north-west to south-east, 11 miles; central breadth, 5 miles. It rises towards its centre, and there attains its greatest height in Mount Delphi. Owing not so much to natural fertility as to careful cultivation, it produces a good deal of wine, oil, and fruit. The town of Skopelos, on its south-east shore, is a Greek see, and has a number of churches and convents. The eparchy of Skopelos includes the Islands of Skopelos, Skiathos, Kilidromi, and some smaller ones. Pop. of Skopelos in 1896, 5295. The pop. of the town is 3779.

SKOPIN, a town in Russia, in the government of Riazan, and 50 miles south of the town of Riazan, on the Verda. It has manufactures of Russian leather and a trade in corn and cattle. A fine breeding-stud, from which the imperial guard is partly supplied with horses, is kept in the vicinity. Pop. (1893), 11,138.

SKUA-GULL. See LESTRIS.

SKULL, the name applied to the skeleton of the head, composed in most Vertebrates of a *facial* and *cranial* portion, and which serves to contain and protect the brain, the chief organs of sense, and other important structures. In the higher forms of Vertebrata the skull forms one mass, with the exception of the lower jaw or *mandible*, which may in the dried skull become detached from the greater mass of bony structures. In the skull of Man most, but not all, of the parts typically seen in the cranium of other Vertebrata may be found. Dividing the skull into the brain-case or cranial portion, and the facial part or skeleton of the face, we may firstly note the broad external features which it presents for observation. We may thus distinguish the projecting, rounded, hinder portion of the skull, formed by the *occipital bone*, and accordingly named the *occiput*. Beneath the occiput the large aperture termed the *occipital foramen*, or *foramen magnum*, is seen, and through this foramen the spinal marrow and brain becomes continuous. The occipital bone at this part also bears two projections, which are named the *occipital condyles*. Each condyle articulates with the cup-shaped depressions on the upper side of the first or *atlas* vertebra. The under surface of the skull exhibits a prominent blunt-shaped process (*mastoid process*), which lies behind and below the opening of the ear. The roof of the mouth, forming the under surface of the face, lies at a lower level than the base of the cranial portion of the skull. In front the *orbis* or eye-cavities, and the *anterior nares* or openings of the nostrils, are seen. The *malar prominences* of the anatomist are the projections of the cheeks, and a bony process, known as the *zygoma*, connects the cheek prominences and face with the skull proper on each side. The bones comprising the skull itself are the *occipital bone*, already mentioned; the *parietal* bones (one on each side), forming the sides of the head; the two *temporal* bones; the *sphenoid* bone, forming the chief element in the base of the skull; the *ethmoid* bone, lying between the skull and face, and between the eye-cavities; the two *maxillary* or upper jaw bones; the *malar* bones; the *nasal* bones; the *lacrimal* bones; the *palate* bones; the *vomere*, forming the partition between the nostrils (which see); the *turbinated* bones; and the *mandible*, or lower

jaw. The skulls of many Vertebrata differ widely from that of man in the relative development of their various parts. Thus the Lancelet (which see), or lowest fish, has no cranium or skull at all; and in higher fishes (for example, Sturgeon, &c.) the various elements of the skull may be more or less coalescent among themselves and with the spine. The bones of the internal ear (see EAR) are sometimes included in the category of the bones of the skull, but are more properly considered and described with the structure of the hearing apparatus. The skull, by some osteologists, has been regarded as being homologous with the vertebrae, and as being thus composed of four modified vertebrae (Owen). This theory—the vertebral theory of the skull—emanating in the first instance from Goethe and Oken, was attacked in 1870 by Huxley and others as being inconsistent with the facts of development. See also special articles, such as ICHTHYOLOGY, ORNITHOLOGY, REPTILIA, &c., in which special descriptions of the skulls of various Vertebrate groups are given, and also EAR, EYE, NOSE, &c.

SKUNK (*Mephitis putorius*), a genus of Carnivorous Mammals, belonging to the Mustelidæ or Weasel family, and to the section Digitigrada of the Carnivorous order. The genus is distinguished by the molar teeth numbering eight in the upper and ten in the lower jaw. The tail is of moderate length and of bushy conformation. The feet have five toes each, and the legs are very short. Like other members of the Weasel tribe, the Skunk has obtained an unenviable notoriety from the odour which emanates from its body, and perhaps of all the Mustelidæ the stench of this form is the most potent and disagreeable. The odour is emitted by the secretion of the *anal glands*, situated, as their name implies, near the anus or vent, and which consist of modified sebaceous glands (which see). The secretion of these glands can be forcibly ejected at the will of the animal, and the stench is so persistent that no amount of washing can remove it from clothes which have been subjected to its influence. This nauseous secretion has been alleged to possess medicinal virtues in curing asthma. When hunted by dogs the Skunk finds a potent means of defence in the secretion of the anal glands, and the dogs are therefore trained to seize the creature suddenly and before it has time to eject their contents. The Skunk inhabits North America, and is especially found in the states of New York and Pennsylvania. It is largely hunted for the sake of its fur, which is of a dark-brown hue, streaked with black tints, and exhibiting streaks of white along the back. The bushy tail is variegated with long hairs of whitish colour. Its average size is about that of a large cat, the tail itself measuring generally from 12 to 15 inches. The Skunk lives in burrows, and appears to be a slowly-moving and somewhat inactive animal. The fur is purified for commercial purposes by heat. The chief exporters of Skunk furs are the Hudson's Bay Company, who send about 10,000 skins annually to Europe. (See the plate at CARNIVORA, fig. 8.)

SKUNK-CABBAGE (*Symplocarpus fatidus*), a plant of the natural order Araceæ or Arums. Among the earliest of the American spring flowers, often, indeed, before them all, appear the large, thick, purplish and spotted spathe of this plant. The leaves are later in making their appearance, are large, and bear no inconsiderable resemblance to those of the cabbage. The whole plant has a strong odour, like that of the skunk, but not comparable to it in intensity. The fruit ripens in September.

SKYE (Scandinavian, 'clouds'), the largest of the Hebrides or Western Isles of Scotland, situated on the west of the county of Inverness, of which it

forms a dependency, and from which, at the narrowest points in the south-east, it is separated by Kyle Rhea and the Sound of Sleat; greatest length, north-west to south-east, about 45 miles; extreme breadth, 24 miles; mean breadth, 15 miles; area, about 535 square miles. It is very irregular in shape, and so deeply penetrated by bays and creeks that it is difficult to find a spot in it 5 miles distant from the sea. The chief sea lochs are Snizort, Dunvegan, Bracadale, Scavaig, Slapin, and Eishart. The coast is rocky and elevated, and generally lined with bold and picturesque cliffs, some of them of very great height; in many localities, but more especially on the north-east, composed of columnar trap, presenting masses of basaltic pillars, not surpassed by Staffa or Giant's Causeway. The interior may be regarded as one great mountainous moorland. The districts of the island are Trotternish, a peninsula in the north, Vatternish and Duirinish in the north-west, Minginish in the middle, and the peninsula of Sleat in the south-east. The highest mountain groups are in the south, where the Cuchullin Hills reach the height of about 3250 feet. They are entirely composed of syenite, are dark in their colouring and rugged and serrated in their outline, presenting some grandly picturesque scenery. They partly form a circular chain round Loch Coruisk; but the loftier portions rise farther west, between Loch Coruisk, Loch Bhreatail, and the Sound of Soay. Farther east the grand mass of Blaven has an elevation of 3042 feet; while to the north-east of this, overlooking a valley or strath crossing the island from Broadford Bay to Loch Slapin, are the Red Hills (2403 feet). Almost the only mineral of Skye that is profitably worked is a crystalline limestone, which furnishes good blocks of marble, both pure white and variegated. In this limestone are numerous caves, one of which, on the north side of Loch Slapin, in the south of the island, is celebrated for its stalactites. In others of them Prince Charles found temporary refuge after the battle of Culloden. The climate of Skye is moist and variable. On several of the loftier heights snow remains till far on in the season, and the melting is frequently accompanied with deluges of rain. Very little of the island is arable, and there is very little wood. The far greater part of the surface is devoted to the rearing of sheep and cattle. Fishing employs many of the inhabitants. Portree, on the east of the island, has an excellent harbour, and has regular steam communication with Glasgow, with Kyle of Lochulsh, the western terminus of the Dingwall and Skye Railway, and with Mallaig, the western terminus of the West Highland Railway. Pop. (1891), 15,763; (1901), 13,883.

**SKYLARK.** See **LARK.**

**SKYROS**, an island in the Grecian Archipelago, about 25 miles east of the island of Euboea; greatest length, N.N.W. to S.S.E., about 18 miles; breadth, 7 miles. It belongs to the nomarchy of Euboea and the eparchy of Karystia. It is very much indented, particularly on the west side, where a bay with an island in front of it forms a large natural harbour. The surface is very rugged, and has numerous steep precipices. In the valleys corn and wine are grown, and numbers of cattle, particularly sheep and goats, are reared. Many of the higher grounds are densely wooded. The chief place, which bears the same name, stands on the east coast of the northern part of the island. The greater part of it consists of a Greek monastery. The inhabitants are deficient in industry, and seem to be generally in wretched circumstances. Anciently Skyros was believed to be the place in which Theseus, the legendary hero of Attica, died and was buried. Pop. of the island, (1896), 3512; of the town, 3300.

**SLAG**, a secondary product of the processes of extracting metals from their ores. It is mainly a compound of silica with alumina or lime, or both, together with various other substances in small quantity. It always contains more or less of the metal from the extraction of which it results. The presence of silica gives a glassy appearance to the mass. Slag is for the most part allowed to lie as refuse, but various attempts have been made to turn it to account, especially by using it for road-making and building. The chief objection to its being used for these purposes is its brittleness, but this defect can be obviated by taking means to cool it very slowly. When this is done blocks of it may be obtained of extreme toughness excellently adapted for road-making, and when the slag contains 38 per cent. or upwards of silica also for building. Such blocks, being completely impervious to damp, are of particular value for the foundations of buildings. In some parts of Belgium the slag is reduced to a fine powder by being exposed to a stream of water on escaping from the blast-furnace, and the powder thus obtained is used to form the moulds for the pig-iron, for which purpose the workmen prefer it to sand. Slag powder is also used in making mortar, and mortar so made has the advantage of hardening rapidly. It is likewise used in some parts for making bricks. Recently a process has been introduced in which it is acted on by steam when in a melted state, and converted into fine threads or filaments, this 'slag wool' being used as a covering for boilers and for other purposes. Some kinds of slag are now largely used as a fertilizer, on account of the phosphate of lime contained in them, being reduced to the form of 'slag phosphate meal' before being applied to the land.

**SLANDER.** See **LIBEL.**

**SLANG**, low or vulgar language, or such as is not recognized in polite and serious literature. The word is said to have been originally the gipsy term for the secret language or *cant*, of gipsies, thieves, and tramps, though some etymologists would connect it with the verb to *sling*, as being originally abusive language hurled or slung at a person. Slang may be said to permeate all classes and to belong to all trades and professions. Some slang words are good old English words preserved in the speech of the vulgar, although lost to the classical English of the present day. A large part of the cant vocabulary is of gipsy origin. A number of other words are derived from foreign languages, and more especially from the Lingua Franca or bastard Italian, spoken among the lower classes at all the seaports of the Mediterranean.

**SLATE**, or **CLAY-SLATE**, called sometimes *argillite*, a well-known variety of rock. By the early English geologists this rock was called *argillaceous schistus*. The structure of slate is eminently foliated or schistose, separating in some of its varieties (as in the roofing slate, for example) into laminae as thin as paste-board. The prevailing colour is gray, of various shades; it is also bluish, reddish, and greenish; opaque and dull; yields to the knife, but varies considerably as respects hardness in its different varieties; fissile: specific gravity, 2.7. When moistened it emits an argillaceous odour. The common roofing slate appears to consist very nearly of the following ingredients:—

Silica .....	48.00
Alumina .....	25.50
Oxide of iron .....	11.30
Potash .....	4.70
Magnesia .....	1.60
Carbon .....	.30
Water .....	7.60

But slate varies exceedingly in its chemical consti-

tution, as might very naturally be expected, since it is a mixed rock, consisting of very minute individuals of quartz, feldspar, and mica, to which are occasionally added scales of talc, and particles of carbonaceous matter. Those slates which contain a large proportion of quartz are called *whet-slate*. In these the mechanical composition is impalpable, and the fracture splintery in the small, though slaty in the large. They are translucent, and of a greenish-white colour. When magnesia enters largely into the composition of slate rocks they are distinguished by their green colour, and by their unctuous feel. These are the slates which, for the most part, have talc as an ingredient, and are often called *talc* or *chlorite* slates. When carbonaceous matter prevails to the proportion of 8 or 10 per cent. the slate soils more or less, and even writes. It is then called *drawing-slate* or *black chalk*. This variety is softer than the preceding kinds, and sometimes possesses the property of adhering to the tongue. Its specific gravity is only 2·18. A variety of slate called *adhesive* slate, from its property of adhering to the tongue, deserves to be mentioned, although it is very remote in its properties from the roofing-slate, which may be considered as the type of the present rock. Fracture, in the large, slaty, in the fine, earthy; colour light gray; specific gravity, 2·08; easily broken; absorbs water with a hissing noise. It consists of

Silica .....	62·50
Magnesia.....	8·00
Oxide of iron .....	4·00
Alumina.....	0·25
Carbon.....	0·75
Water .....	22·00

Still another argillaceous aggregate, which has been treated of along with the slates, is the *polishing* slate. It differs from adhesive slate in not adhering forcibly to the tongue, in being very soft, and in having a low specific gravity, namely, 0·50 to 0·60.

Slate, in varieties approaching roofing-slate, occurs in vast strata in primitive countries, and is often observed graduating into mica-slate. Wherever its strata are contiguous to granite, gneiss, or mica-slate it is noticeable that it has a more shining lustre; as it recedes, however, from the primary rocks, its texture is more earthy. It is commonly divided into beds of various degrees of thickness, which are generally much elevated; and, from the natural divisions of the rock, they often form peaked and serrated mountains. The cleavage of these beds is in a transverse direction, making with the slope of the bed an angle of about 60°. The finest variety which is used for roof-slate seldom forms entire mountains, but is generally embedded in slate rocks of a coarser kind. Those kinds are selected for the covering of buildings which have the smoothest surface, and split into the thinnest plates. Quarries of slate of this description are worked extensively in Westmoreland, Yorkshire, Leicestershire, North Wales, Cornwall, and Devonshire. *Whet-slate* is found in beds between strata of common slate in transition formations. The use of this variety for hones and whet-stones is well known. The most valuable kinds come from Sonnenberg in Meiningen, and from Saalfeld. They are likewise brought from the Levant. The drawing-slate, which is used as a drawing material, comes from Italy, Spain, and Bayreuth in Thuringia. Adhesive slate occurs only at Menil Montant, and Montmartre, near Paris. Polishing-slate, which Ehrenberg discovered to be entirely composed of the skeletons of Infusoria, occurs at Planitz, near Zwickau, and near Bilin in Bohemia. It is used as a polisher of metals.

SLATE-CLAY. See CLAY.

SLATE-PENCILS are made in two ways, being

either cut or turned pieces of solid slate, or slate powder moistened and solidified into sticks by pressure.

SLATER, the popular name applied to the members of the family Oniscidae or Wood-lice, Crustacean animals belonging to the order ISOPODA (which see) of that class. The Common Wood-louse or Slater (*Oniscus* or *Porcellio scaber*, see Plate CRUSTACEA, fig. 23) is commonly found beneath stones, among damp moss, and in similar situations. The colour is a dull leaden hue, which sometimes exhibits white spots. The Land Slater (*Oniscus asellus*), is another familiar species, and is spotted yellow and white. This latter species possesses eight joints in the outer antennae, the Common Slater possessing but seven joints. In addition to these familiar forms, we may note the Water-slators belonging to the genus *Asellus*, and found in fresh-water streams and ponds. The Great Water-slater (*A. aquaticus*) averages about half an inch in length, the males being larger than the females, contrary to the general rule amongst these animals. The Rock or Sea Slators (*Ligia*) are represented by the Large Sea-slater (*L. oceanica*), inhabiting our sea-shores, which species is coloured grayish or of a brown hue. Other genera of Slators are the Box Slators (*Idothea*), the Shield Slators (*Cassidina*), and the Cheliferous Slators (*Tanais*). The latter possess a carapace or investing shell, the margins of which, being highly vascular, constitute the respiratory or breathing organs.

SLAVE COAST, a maritime strip on the west of Africa, extending between the Volta and Akinga, a stretch of about 240 miles. It consists mainly of long narrow islands, two of which almost completely bar the entrance to two sheets of water called the Avon and the Denham Waters. The principal towns on the coast are Badagry and Whydah. The former kingdom of Dahomey extends over a great part of the territory bounded on the south by this coast. The name of Slave Coast is due to the fact that during the prevalence of the slave-trade it was from the ports of this region that the slaves were principally obtained. The French now possess both the coast here, and also the 'hinterland', having appropriated the territory of the King of Dahomey, with whom they came into hostile collision.

SLAVE LAKE, GREAT, a large lake in British North America, between Hudson's Bay and the west coast. It is of extremely irregular form. Length, north-east to south-west, upwards of 300 miles; greatest breadth, 50 miles. Area, estimated at 10,100 square miles. Its northern shores are precipitous and rugged, and it contains many rocky and wooded islands. On the south it receives by the Slave River the waters of Lake Athabasca, and its own waters are discharged by the Mackenzie, which issues from it at its western extremity. The western shores of the lake are well wooded, but its eastern part is within the Barren Grounds. On its shores are Fort Resolution, Fort Reliance, and Fort Rae, of the Hudson Bay Company.

SLAVE LAKE, LESSER, a lake in the Dominion of Canada, in Athabasca Territory, about 270 miles south-west of Lake Athabasca. It is about 60 miles long, and its greatest breadth is about 12 miles. The surface of the lake is 1890 feet above sea-level. It drains into the Athabasca river, and has been known to keep free from ice till Christmas.

SLAVERY. Slaves were probably at first captives. It being considered that the victor had a right over the life of the vanquished, the latter was looked upon as altogether at the disposal of the former, who, if he chose to spare him, might subject him to any restraint that he saw fit. Slavery existed among all nations of antiquity with so little variation in the

nature of the institution that it is unnecessary to give details relating to the several countries. It will be enough to mention one or two of the more striking features of slavery as it existed among the Hebrews, Greeks, and Romans. The ancient Hebrews were permitted to have slaves even of their own nation, but every seventh year such slaves were released, and their owners were enjoined not to send them away empty, but to supply them with cattle and other necessities (Deut. xv. 13). If, however, the slave preferred to remain with his master, he had his ears pierced in token of his voluntary servitude. The piercing of the ears and the wearing of ear-rings was a common symbol of slavery among the nations of antiquity, as it still is very generally in the East. In Greece slaves were sometimes prisoners taken in war, but most commonly they were purchased. The people of the Island of Chios are said to have been the first to make a traffic in slaves. At Athens, in conformity with the character of the people, slaves were commonly treated with mildness. Frequently they were set free by their owners, and then they belonged to the class of *meteci*, who did not enjoy full rights of citizenship, and were required to pay a small annual tribute to the state. Freed slaves still owed certain duties to their former masters, whom they had to regard as their patrons. What the nature of the services that their patrons might require of them was is not known, but in case of their being neglected the freedmen could be prosecuted and punished. In Sparta the slaves were treated with great harshness, the Spartan youth being encouraged to exercise all manner of cruelty on them. The slaves of the ancient Romans were mostly captives. In the early history of Rome there were comparatively few slaves, for it was then the practice of the Romans to transport the inhabitants of a conquered territory to Rome, and give them the rights of citizenship. Afterwards modified rights of citizenship were granted to conquered tribes in their own lands; but even before the conquests of Rome had extended beyond the limits of Italy, it had become common to reduce prisoners in war to the condition of slavery. The severe laws of debt among the Romans allowed creditors to make slaves of debtors that were unable to pay. In both of these ways the number of slaves among the Romans grew rapidly, till in the latter days of the republic slaves formed a large part of the population of Italy. From the year 264 B.C. slaves were employed by the Romans in their gladiatorial exhibitions. The severity with which they were treated often provoked them to insurrection. Twice in Sicily, about 140, and again about 104 B.C., a regular servile war broke out; but the most dangerous rising among the slaves was that headed by the gladiator Spartacus, which took place in 73 B.C. Under the republic several attempts were made to ameliorate the condition of the slaves; but these attempts all failed since they were regarded as invasions of the rights of private property. It was not till the time of the empire that the arbitrary power of a master over his slave was limited, and the slave received a legal status. A slave that had been ill-treated acquired a right to the protection of the emperor by fleeing to the feet of his statue. Antoninus Pius took away from the masters the power of life and death over their slaves. For an account of the methods of manumission among the Romans see **FREEDMEN**.

In no country have the evils of slavery been so strikingly exemplified as in ancient Rome, of the ruin of which slavery is generally held to have been one of the principal causes. It killed free labour. This it did first in the work of tilling the ground. In consequence of the Roman practice of appropriating

a share of conquered lands as *ager publicus*, which, in spite of regulations to the contrary, fell mainly into the hands of the rich patricians, a large part of the soil of Italy came into the hands of comparatively few owners, who cultivated it by means of slaves. The evils of this practice were early discerned by the Romans themselves, and various enactments were made to check it. But all these efforts were unavailing. On the contrary, the evil spread to other branches of labour; and rich capitalists began to carry on all industries by means of slave labour, with which free labour was unable to compete. The result was that all, except the monied classes in Rome, were reduced to the condition of an idle rabble, depending for support on the bounty of the emperors.

By some of the nobler minds both in Greece and Rome protests were made from time to time against the rigours of slavery, but it was long before any among them had the insight to condemn the practice itself. After the subjugation of Greece by the Romans, and the consequent reduction to slavery of many men more civilized and refined than their conquerors, the Romans gradually began to feel the enormity of the practice, and at last we find Seneca expressly denying the right of one man to make another his slave, and asserting the natural equality of all men. Later Epictetus speaks in almost the same terms; and the jurist Florentinus defines slavery in *The Digest* (tit. v. sec. 4) as 'an institution of the law of nations by which a person is, contrary to nature, subjected to the dominion of another.'

The early Christian church did nothing to suppress slavery, and slavery and the slave-trade continued to exist for 1000 years in the Christian nations of Europe that rose on the ruins of the Roman Empire. Yet the ultimate extinction of slavery must be ascribed in a great measure to the influence of Christianity, for although the church never formally pronounced against it yet the ministers of the church often induced masters to liberate their slaves, promising rewards in the next world for so doing. This, however, was chiefly or exclusively the case where both the masters and the slaves were Christians. Where wars were waged between Christians on one side and unbelievers on the other, as between the Germanic and Slavonic nations, the prisoners on both sides were generally reduced to slavery. As in these wars the Germans usually had the upper hand, and made prisoners in great numbers, these were sold into France, England, Italy, and even the Eastern Empire (Constantinople), and the very word 'slave' (in German, *sklave*, French, *esclave*, Spanish, *esclavo*, Italian, *schiavo*), which is probably the same with the national name of Slave, is an evidence of the extent to which this was carried. It is not till the thirteenth century that the severity of slavery began to decline in Europe. The slave-trade gradually died out; the great slave markets on the Baltic and the German Ocean ceased to exist; and the slaves, who had hitherto been treated simply as property, began to have certain rights of protection acknowledged. The condition of serfdom took the place of that of slavery, and ultimately this too was everywhere abolished. Its extinction in England dates from the year 1680. Yet slavery, even in the strict sense of the term, cannot be said to have disappeared from Christian Europe for more than a century after that date, for as late as 1770 the galleys of the Maltese knights were rowed by Mohammedan slaves, and serfdom was not abolished in Russia till 1861.

Among Mohammedan nations slavery has never ceased to exist. The Koran expressly allows the acquisition of slaves by conquest; yet it seems to be the case that Mohammedans did not actually resort to this method of acquiring slaves till the time of

the Crusades. At the court of the caliphs the only slaves were negroes obtained in the way of commerce. About the time of the Crusades the Mohammedans began to obtain white slaves not only by war but also by purchase, being furnished with this commodity by Venetian merchants, who obtained their supplies from the coasts of the Adriatic inhabited by Slavonians, or perhaps from the markets where those captured by the Germans were exposed for sale. The Mohammedans of the Barbary States also obtained white slaves by piracy in the Mediterranean, of which they were the pest even down to the present century. Various Christian powers at different times undertook expeditions against one or other of these states. Ximenes, under Ferdinand of Spain, conquered Oran (1508); the Emperor Charles V. in 1535 made war against Hayraddin Barbarossa, sultan of Algiers, and having defeated him set free 20,000 Christian captive slaves; Blake in Cromwell's time destroyed the greater part of the united fleets of Tunis and Algiers (1655); but the effects of these and other expeditions were only temporary. Treaties concluded with the separate states were observed only as long as the powers that had exacted them took the means to enforce them. The expedition under Lord Exmouth in 1816 against Algiers resulted in a treaty which declared the slavery of white captives abolished; but the piracy of that country was not finally stamped out till its occupation by the French in 1830.

After slavery had become all but extinct in Europe it had a new birth in the American colonies of European origin. It was not then that negroes began to be seized as slaves by Europeans, but before the demand for slaves arose in the colonies negro slavery as practised by Europeans was insignificant. The original seat of the slave-trade in West Africa is the whole of the coast between Gambia and Sierra Leone. It is stated that in 1434 this region was visited by a Portuguese captain, Gonzales Baldaya, who then carried away some coloured lads, whom he sold advantageously to the Moors in Spain. Six years later he returned and committed a similar robbery. The negroes that he captured on this occasion were presented to Pope Martin V. About a score of years later Nicholas V. in a special bull expressly allowed the Christians to reduce non-Christians to slavery, and although in 1462 Pope Pius II. blamed the Portuguese for enslaving negro neophytes it was long before the head of the Roman Catholic Church pronounced any condemnation of the slave-trade generally. Towards the end of the fifteenth century the slave-trade was growing in extent, and in 1480 Pedro de Cintra founded Sierra Leone, and in the following year the fort of Elmina, with the view of increasing the facilities for it. But, as already stated, it was not till after the foundation of the European colonies in America that it began to develop to the extent to which it ultimately did. The first shipment of negroes to the New World took place in 1503, when the Portuguese landed some in St. Domingo. From that time to the present century a traffic in negroes across the Atlantic was carried on by the Portuguese, and after them by all the Christian colonial powers, with an atrocity at which nature revolts, and which could never have reached the height that it did if the colour of the slave had not given rise to the idea of his being by nature a degraded being. In defence of this trade it has been urged that in the tropical and sub-tropical regions of America the development of the colonial system would have been impossible without the transmission of negroes, and it has been observed that negro slavery has only been found necessary and has only been established in those regions where the native population consisted of nomadic tribes supporting

themselves by fishing and hunting, and incapable of being trained to agriculture, as is the case with the best arable lands of America. But whether this is the case or not (and it is not generally admitted) it is the fact that the slave-trade flourished for centuries under the countenance of the most enlightened nations of Europe. It was even introduced into some of our own colonies against their will. Some of them made repeated efforts to prevent the importation of slaves, but could not obtain the consent of the English government. (See Walsh's Appeal from the Judgments of Great Britain—Philadelphia, 1819.) In the ninth section of that work the subject is fully discussed. The constitution of the United States acknowledged slavery by the provision that 'representatives and direct taxes shall be apportioned among the several states which may be included within this Union, according to their respective numbers, which shall be determined by adding to the whole number of free persons—including those bound to service for a term of years and excluding Indians not taxed—three-fifths of all other persons.'

As soon as dealing in slaves began to be a lucrative branch of business governments began to look to it as a source of revenue. They sold licenses to carry it on, or monopolies to private companies, or concluded agreements by which a certain number of slaves was to be brought annually to a certain place, charging at the same time a certain sum for every slave so landed. In 1517 Charles V. granted to his favourite, Lebrera, the exclusive privilege of importing annually 4000 slaves, which were sold to the Genoese. In 1537 a slave market was set up with the express permission of the pope at Lisbon. In 1562 the English first took part in the trade. Captain Hawkins was the first Englishman who did so, and he was rewarded by Elizabeth with knighthood for having conferred on English commerce so signal a service as to point the way to this profitable employment for English ships. In 1618 James I. allowed Sir Robert Rich a charter for the formation of a company to carry on the trade, and as this company turned out unsuccessful a second was formed in 1631. In course of time the English outdid all other nations in the extent to which they carried on this traffic, as also, it is said, in the cruelty with which they conducted it. In 1713 an *asiento* (consignment) engagement was entered into between Spain and the English South Sea Company, according to which the latter was to supply the Spanish colonies with 4800 yearly, paying a duty of 33½ piastres on each. In 1762 the Duke of York was at the head of another English company which engaged to transport 3000 slaves a year to Jamaica. In the eighteenth century the English slavers ruled the Middle Passage, as it is called, that is, the region of the great Atlantic current which runs westwards from equatorial Africa and then divides into two branches, one of which proceeds onwards to the Caribbean Sea, while the other turns south to South America. This region swarmed with slave-ships during the prevalence of the trade. When the traffic was at its height it is said that no fewer than seventy ports, from the Cape Verde Islands to Benguela, were engaged in it. The most important markets were Bonny and Calabar. About 1770 nearly 200 English vessels (mostly belonging to Liverpool) were employed in the traffic. The trade also became a great source of profit to the petty African despots. The powerful became chiefly occupied with forcing their brethren to the market of Christian Europeans to barter them for rum and toys. It is, however, too much to say that the slave-trade is responsible for all the atrocities of which these petty chiefs are guilty in their internecine wars. The state of constant enmity and strife with one another in which they live was not due to the slave-trade, which

only made this difference, that the prisoners taken by the stronger side were sold into slavery instead of being butchered. It is true that the hope of making gain in this way might serve as an inducement to some aggressive chief to undertake a war when there was no other reason for doing so; but if the truth is, as it is said to be, that inducements for such a step among the African tribes are never wanting, this fact does not count for much. Since the prohibition of the slave-trade and the great efforts which have been made for the capture of the slave-ships, though the trade on the west coast of Africa has been almost extinguished, yet the cruelty with which it is carried on at the few points to which it is now confined is often increased because the slave-trader, being obliged to guard against capture by the men-of-war who are watching his movements, and, altogether, to carry on his traffic by stealth, subjects the slaves to many restraints for the purposes of concealment which he did not find necessary while the slave-trade was legal. It is now only in the interior of Africa that the slave-trade is carried on with activity, and even there it is much shorn of its profits for want of foreign markets.

The first persons who liberated their slaves, and laboured to effect the abolition of the slave-trade, were some Quakers in England and North America, particularly since 1727. In 1751 the Quakers entirely abolished it among themselves. Granville Sharp in 1772 effected the acknowledgment, by the English courts, of the principle that the slave who lands in England becomes free. The principle had been earlier adopted in France. In 1783 a petition was addressed to Parliament for the abolition of the trade, which Wilberforce eloquently supported. He laboured at the same time to aid the cause by his pen. But the soul of all the efforts for the abolition of the slave-trade was Thomas Clarkson. From early youth he devoted his whole time and fortune to this object; exposed himself to hatred and outrage, even at the hazard of his life, in Liverpool and Paris; made numerous journeys, and was deterred by no obstacles. He principally contributed to gain over Wilberforce, Pitt, and Fox. The subject of the abolition of the slave-trade was introduced into the House of Commons in 1788, when Pitt presented a petition against the trade. Many petitions followed, upon which the merchants immediately took the alarm. They calculated that the number of slaves in the West Indies amounted to 410,000, and that to keep up that number the annual importation of 10,000 was required; that the English bought in Africa 30,000 annually, and therefore could sell 20,000 to other nations; that in the prosecution of this trade English manufactures to the amount of above £800,000 sterling were exported, and above £1,400,000 in value obtained in return; and that government received £256,000 annually by the slave-tax. Liverpool and Bristol, which carried on the slave-trade most extensively, resisted its abolition so violently that Wilberforce, Fox, Pitt, and their friends could effect nothing more than the institution of an inquiry into the trade, and the passage of some provisions for diminishing the hardships of the confinement on ship-board. At length the House of Commons was induced, in 1792, to pass a bill for the abolition of the slave-trade in 1795, by a majority of nineteen; the Lords rejected this as well as the bill proposed by Wilberforce in 1794 for prohibiting the British from selling slaves to other nations. In the meantime the French National Convention, February 4, 1794, had declared all the slaves in the French colonies free. Wilberforce brought in another bill with a like object in 1796, but it also was rejected. The African Society, established by Wilberforce and Clarkson,

now redoubled its efforts to convince the public of the horrors of this traffic, and at length the cause of humanity triumphed. June 10, 1806, Fox moved that the House of Commons should declare the slave-trade inconsistent with justice, humanity, and sound policy, and immediately take effective measures for its abolition. The motion was agreed to, and a petition was presented to the king requesting him to take measures to induce the other powers of Europe and the American States to co-operate with Great Britain in the suppression of this traffic. The famous Abolition Act, as finally settled, passed in March, 1807. January 1, 1808, was fixed as the time when this trade, on the part of the British, should cease. Another act, May 4, 1811, provided that all who knowingly participated in the slave-trade should be punished with fourteen years' transportation and hard labour. In 1824 a law was passed for declaring the slave-trade piracy, as had been already done by the United States of America, which abolished the trade in the same year as ourselves. In Denmark King Christian VII. in 1794 declared the slave-trade unlawful after January 1, 1804; and Frederick VI. promised at the Peace of Tilsit to prohibit his subjects from taking part in the foreign slave-trade. In France Napoleon, when first consul, promised the continuance of their liberty to the inhabitants of St. Domingo, whilst he praised the inhabitants of Isle de France (Mauritius) for not having freed their slaves, and promised that France would never again decree the slavery of the whites by the liberation of the negroes. After the successes of the French in St. Domingo the slave-trade was once more established. In 1814 Lord Castlereagh obtained from Louis XVIII. a promise that France would abolish the slave-trade, but by the influence of the chamber of commerce at Nantes this traffic was permitted for five years more. Its abolition by most of the other European powers, as well as those of America, was gradually provided for by treaty. The task of enforcing the treaties fell mainly on Britain, which long maintained off the west coast of Africa a squadron (commonly known as the 'coffin squadron,' from the insalubrity of the climate) for the suppression of the traffic. In 1819 a society was formed in England for the settling of free negroes in Africa. The society bought the island of Sherbro, on the coast of Sierra Leone, and in 1820 brought thither a number of emancipated negroes, but these were not able to maintain themselves against the natives. In 1821 the North American abolitionists founded a colony for emancipated negroes on Cape Misurado, and this attempt was more successful. The colony still exists under the name of Liberia, which it took in 1824; but it cannot be said to have fulfilled the extravagant expectations of the philanthropists to whom it owed its origin. See LIBERIA.

The abolition of slavery itself gradually followed that of the trade in slaves. In some of the Northern States of America, where the economical conditions were favourable to its abolition, this took place very soon after the declaration of independence, and in 1820 the parallel of 36° 30' north latitude was fixed as the northern limit of slavery. In 1831 the British government emancipated all the slaves of the crown, and on the 14th of May, 1833, the Whig administration of Earl Grey brought forward a plan for entirely abolishing slavery in the British colonies. The first proposition was that the slaves, after a probationship or apprenticeship of ten years, in order to prepare them for their liberation, should be emancipated, and that the slave-holders should in compensation be accommodated with a loan of £15,000,000 sterling, to be repaid in such manner and at such rate of interest as should be prescribed by Parlia-

ment. In the form in which the bill finally passed, the slaves were to receive their freedom on the 1st of August, 1834, but a six years' apprenticeship, to begin after that date, was imposed on plantation slaves, and an apprenticeship of four years' duration on domestic slaves; and the sum of £15,000,000 was raised to £20,000,000, to be distributed, not as a loan, but as a *gift*, among the slave-holders, in order to compensate them for any loss which they might be supposed to suffer by the arrangement. A nobler sacrifice of money to humanity and justice was never before made by any nation.

In the French colonies slavery was abolished by the provisional government of 1848. Sweden provided for its abolition in 1846, Denmark in 1848, Portugal in 1856, Holland in 1863, the United States by proclamation in 1863 and by constitutional amendment in 1865. In 1873 the Spanish government abolished slavery in Porto Rico, and in 1886 it finally came to an end in Cuba. In Brazil slavery existed till 1888. Some of the countries that were latest in adopting the policy of emancipation, profiting by the experience of those who had preceded them, showed more prudence than the latter in the way in which the emancipation was accomplished by them. The Dutch paid the owners of slaves only a moderate indemnity, and placed all emancipated slaves under the inspection of government, requiring each of them either to show that he was doing something to make a living or to work in the public works for a small wage. Brazil went still more cautiously to work, not only adopting this provision of the Dutch but also extending the act of emancipation over a series of years. (See BRAZIL.) In no country of the world did negro slavery lead to such difficulties as in the United States, but an account of the slavery question there rather belongs to the history of that republic than to the history of slavery.

The treaties above referred to as concluded with various powers in Europe and America for the suppression of the slave-trade were directed mainly against its continuance on the west coast of Africa, and the result here was quite successful. The efforts that were made to put a stop to it also on the east coast have not hitherto proved so successful, however, although Britain has long had cruisers in the Indian Ocean for the express purpose of intercepting cargoes of slaves conveyed by Arab vessels to Mohammedan countries. In a great part of Africa slavery is still an institution, and slaves are still brought from immense distances to Morocco, Tripoli, Fezzan, &c., and are also conveyed across the Red Sea to Arabia, though this traffic is now carried on to a comparatively small extent. Frightful ravages by slave-traders were long committed in the lake regions, about the Victoria Nyanza, Tanganyika, and Nyassa, as well as on the Upper Congo and elsewhere. Here, indeed, whole districts formerly occupied by a dense and industrious population were depopulated by the slave-raids. Those chiefly engaged in the trade were Arabs, so-called at least, usually half-breeds of the vilest character. One method of procedure was this:—A trader hired 200 or 300 men, and proceeded to the quarter where he purposed to commence operations. He was sure to find somewhere two of the petty chiefs at feud with one another; and with one of these he formed an alliance, and along with him attacked the other, shot down the men of his tribe, and carried off the women and cattle, allowing only a small reward to his ally. Very often the Arab trader took occasion to quarrel with the latter, whereupon he was himself treated as his rival chief had formerly been. The slaves were ultimately destined for Mohammedan masters, and although the cruelties practised in catching them, and after

they were caught till they came into the hands of their masters, were as great as those that were wrought in the West African slave-trade, yet when the slaves reached their final destination their lot was not only much milder than that of their brethren was, as a rule, under European masters, but even than it was while they were in their own country; for Mohammedans, who only require slaves as an appendage to a luxurious life, have always been known as mild masters. The suppression of this vile traffic was one of the objects of the expedition up the Nile conducted by Sir Samuel Baker at the instance of the Egyptian government in 1870-73; and much more vigorous and effective measures were carried out by General Gordon in 1877 and subsequent years. But the rebellion of the Soudanese under the Mahdi, and the giving up by Egypt of the equatorial possessions formerly administered by it, for a time undid to a great degree the good that had been effected in this region. In 1873 a treaty was signed between Britain and the Sultan of Zanzibar, stipulating for the suppression of the slave-trade within the dominions of that sovereign; and immediately after its signature the slave-market at Zanzibar was closed, but only a small portion of the traffic was thus affected. The recent extension of European influence in Africa, especially that of Britain and Germany over large portions of Eastern Africa, and the spread also of missionary enterprise, have done much to check the slave-raids.

SLAVES, or SLAVONIANS, a branch of the Indo-European family of nations, among which it is most nearly allied to the Lithuanian and more distantly to the Germanic branch. The native form of the name is Slovene or Slovjene (in the singular Slovenin or Slovjanin). The forms Slavjane and Slavjanin are more modern, and only found in books. They occur for the first time after the beginning of the seventeenth century. The derivation of the name is unknown. The name of Wends or Winds was at one time a general designation of the Slavonians, but the Slavonians themselves in the earliest times designated themselves by that of Servians, which name at present is confined to a particular section of the race. According to Schafarik the Slavonians occupied from a period long before the beginning of the Christian era until the fifth century after Christ the whole of the land to the north and east of the Carpathian Mountains, from the Baltic, Lake Ilmen, and the Volga to the Black Sea, and probably also the regions of the Lower Danube. But if these last-named regions were ever possessed by them they were very early expelled from them by the Celts, and in the beginning of the fourth century they were driven away from the Baltic coasts by Germanic tribes. Large numbers of Slaves were again pressed westwards by the advance of the Huns, and at the end of the fifth and the beginning of the sixth century they are found to be again in possession of the northern banks of the Lower Danube, whence they passed over to the southern banks, occupying Moesia and Thrace. They had already extended themselves further west in the north also; for after the emigration of the Vandals, Burgundians, and other Germanic tribes in the fifth century Slaves succeeded them in the occupation of the lands stretching between the Oder and the Saale and Lower Elbe. About the end of the same century Slaves peopled Bohemia and Moravia; and before the end of the sixth century they had also penetrated into Transylvania, Hungary, Upper Austria, Styria, Carinthia, and Carniola. The Slavonic tribes of Chorvatians (Croats) and Servians settled probably between 634 and 638 in Dalmatia and the whole of ancient Illyricum (Boenia, Servia, and the neighbouring districts).

Finally, Slavonic tribes spread from their first settlements also to the north and east, over the remainder of modern Russia. Of this wide territory the Slavonians again lost in process of time the Elbe and Oder regions, Upper Austria, and part of Carinthia and Styria, of all of which they were deprived by Germanic tribes; large parts of Transylvania and Hungary, which fell to Rumanians and Magyars; and parts of the regions on the south of the Danube, which came into the hands of Greeks and Turks.

The Slaves in the districts in which they still exist form two great groups, the south-eastern and the western Slaves. The former include (1) Bulgarians, (2) Servians, (3) Croats, (4) Slovenians, (5) Russians (comprehending Little, Great, and White Russians); and the latter include (1) Czechs (comprehending Czechs in the narrower application, Moravians, and Slovaks), (2) Sorbs (Lusatians), divided into Upper and Lower Sorbs, and (3) Poles (Leches), with the allied Cassubians. To the western Slaves there formerly belonged also the Slavonic inhabitants of the so-called Hanoverian Wend-land, in the Lüneburg district, on the banks of the Elbe (Polabians), but these have now completely died out since about the middle of last century. The total number of Slaves is said to be about 116,000,000, five-eighths of whom are Russians. With few exceptions the Russian and Bulgarian Slaves belong to the Greek Church; the western Slaves, except a few Lusatians, to the Roman Catholic, as do also the Slovenians and Croats; the Servians are divided between the two churches. In Bosnia and Bulgaria there are a few Mohammedans.

The notices of the Slavonians that are found in the ancient writers seem to show that the state of civilization among them was pretty much the same as that described by Tacitus as obtaining among the Germans at that time. They pursued agriculture, lived in towns and villages, and possessed a complete system of worship, with sacrifices, festivals, and images of gods. They also possessed, like the Germans, a Runic alphabet and a widely diffused popular poetry. Even yet the Slavonians generally, but more especially the southern Slavonians, are distinguished among the nations of Europe for their tenacity of ancient popular poetry. Their political system seems to have been a very loose one, grounded on a very free communal government.

*Literary Dialects.*—Eleven different Slavonic literary dialects may be enumerated—(1) Old Bulgarian (ecclesiastical Slavonic), (2) New Bulgarian, (3) Servian (Illyrian, Ragusan, Croatian), (4) Slovenian, (5) Great Russian, (6) Little Russian, (7) White Russian, (8) Czech or Bohemian, (9) Slovak, (10) Polish, (11) Sorbian (Upper and Lower Lusatian). The dialect in which the Old Bulgarian or Cyrillian literature is composed is now dead, although, in the ritual of the Greek Church, especially among the Russians, Bulgarians, and Servians, service-books written in it are still used. The New Bulgarian literature, composed in the speech of the modern Bulgarians, which is considerably different from the Old Bulgarian dialect, is only now taking its rise. The Little Russian and White Russian dialects were at one time, especially at the period of Polish domination, largely used in literary production (for religious, historical, legal, and other works); but the latter is now almost entirely disused for literary purposes, and the former only used in poetry, popular tales, and other lighter departments of literature. Colloquially both dialects are still in vigorous existence; but their affinity to the Great Russian prevents them from being employed in any considerable literary works. The Servian and Slovenian dialects are essentially one, but have nevertheless, in conse-

quence of political, religious, territorial, and even of alphabetical grounds of separation, produced several distinct literatures—Servian proper, Ragusan, Croatian, and Slovenian. This separation, having lasted through centuries, is now on the point of being got rid of. With respect to the first three, this has already been accomplished; but there are greater hindrances in the way of its being effected in the case of the Slovenian, the dialect of which presents greater differences as compared with the Servian than the dialects of the other literatures mentioned do. The Slovak has never attained any great importance as a literary dialect. Although in many respects different from the Bohemian, the latter has always formed the true literary dialect. The two Lusatian dialects preserved their independence, but never, except at the Reformation epoch, attained any considerable degree of literary activity. The dialect of the Polabians of the Elbe and Northern Germany, a dialect more nearly akin to the Polish than to any of the other Slavonic dialects, has no literary monuments except a few linguistic fragments, such as a few prayers and collections of words. Setting aside those dialects which have altogether died out, and those which are no longer productive in a literary sense, as well as the Lusatian, Slovenian, and New Bulgarian, on account of the insignificance of their literary products, we obtain four principal dialects and literatures in which the Slavonic character has developed and revealed itself, namely, the Czech or Bohemian, the Polish, Russian, and Servian. (See the separate articles.) Philologically the Bohemian and Polish (together with the Lusatian dialects) belong to the western group, and the Russian and Servian (together with the Old and New Bulgarian and the Slovenian) to the south-eastern. Two alphabets are used by the different groups, the western group using the Latin, and the south-eastern (except those belonging to the Roman Catholic Church) the Cyrillian. Formerly, also, the Glagol alphabet was in use for ecclesiastical books, especially among the Dalmatians, and the so-called Gothic alphabet among the western Slaves.

*Slavonic Mythology and Religious Rites.*—The derivation and historic development of the Slavonic mythology are still problems for scholars. The difficulty in solving these problems arises not so much from the want of material as from the heterogeneity of that material. The Slavonic mythology contains in its elements derived from most of the Indo-European nations with which the Slaves, themselves an Indo-European people, have at any time come into contact. Indian, Persian, Græco-Roman, Celtic, Germanic, Scandinavian, and Prusso-Lithuanian elements, and even some derived from sources outside of the Indo-European family (Finnish), can all be traced in their mythology. Few writers on Slavonic mythology have attempted to treat the subject from a truly scientific point of view, to determine, so to speak, its scheme. Most of them assume that there is no such scheme, recognizing in the features of that mythology that have come down to us only an aggregate of disconnected parts native and foreign, or bringing the Slavonic deities into connection with the Græco-Roman Pantheon, and explaining the former by the latter. Among the few who have not rested satisfied with assumptions of that sort are Lelewel, Kollar, Schafarik, Maciejowski, and Hanusch. The work of the last mentioned, *Die Wissenschaft des slawischen Mythus* (Lemberg, 1842), is the most complete and scientific of them all.

The result of the labours of these and other inquirers seems to be that the foundation of the Slavonic mythology was a monotheistic system, or at least a system that recognized one God as lord over all, supreme over

nature and its powers, over man, and other beings superior to man and possessing a sort of divine power. The earliest testimonies to the nature of the Slavonic beliefs are those of Procopius, writing in the sixth century, and Helmold, writing in the twelfth. The former says of the Slaves beyond, that is, south of, the Carpathians: 'They worship a God, the creator of the lightning, and the supreme lord of all. They sacrifice bulls, and render offerings of all sorts to him. They know nothing of fate, and assign to it no influence on human affairs. In cases of imminent danger of death, whether by sickness or in battle, they make a vow to God, and when the danger is past they faithfully keep the vow, believing themselves to have been delivered in consequence of it. They worship also rivers, nymphs, and a number of other deities, to all of which they pay offerings, combining divination with these rites.' Helmold, speaking of the Polabian Slaves of North Germany, says: 'In addition to the deities of various form to whom they assign the fields and woods, sorrow and joy, they believe in a God who reigns over the others in heaven; and who, concerning himself, as the almighty one, only with heavenly things, leaves all other duties to the lower divinities, who have sprung from his blood, and who rank in relation to one another according to their nearness to the God of gods.' These two testimonies are of the greatest value, showing as they do that the same religious ideas prevailed among the Slaves at widely different parts, and at periods separated by a long interval of time, and furnishing us with the leading conceptions with reference to which all the other elements of the Slavonic mythology must be understood.

This account is not, however, universally accepted. Some maintain that there were several deities that were generally worshipped as of equal rank by the Slaves. The advocates of the monotheistic view say that Sviatovit was supreme; but the holders of the other opinion assert that Perun and Radegast, and perhaps others, were equal to if not above Sviatovit. Of these three Grimm makes a trinity, in which he considers Sviatovit as corresponding to the Zeus of Greek, the Mars of Roman, and the Tiu or Tyr of Scandinavian mythology; Perun as equivalent to Jupiter and Donar, and Radegast to Mercury and Odin. Besides the three deities Sviatovit, Perun, and Radegast, the following may be mentioned as having had a general worship paid to them—Prove, the god of justice; Rugevit, of war; Siva, or Ziva; Triglav (Trimurti); Lado and Lada, divinities of order and love; Dievana (Diana), goddess of the woods; Prija, the Scandinavian Freya; Bjelbog, the white god; Cernobog, the black god; Morena (Marzana), goddess of death; Jutrebog, god of the morning; Vegada, the weather god; and good and bad demons—Djasi, Diei, Biesi, Dievy, Lutioe, Skrety, &c. The forms of the Slavonic deities recall to mind those of India. Sviatovit was represented as four-headed. A stone statue of him was discovered at Zbrucz in Eastern Galicia, and has been set up at Cracow. Perun was represented as four-faced, &c. The Slavonians are said to have believed in the immortality of the soul, the resurrection of the dead, and a retribution beyond the grave. Their principal celebrations were *kobiada*, a feast held at the beginning of the year, when an interchange of presents was customary; *kupalo*, a feast that took place in honour of the sun at the time of the summer solstice; and *trizna*, celebrated in honour of the dead. Religious services were performed by the priests, who, in the earliest times, seem to have been also the rulers of the people, as is established not only by historical testimony but also by the double sense of the Slavonic words still in use, *kriadi*, *kries*, mean-

ing both priest and prince. The offerings rendered to the gods by the Slavonians consisted in cattle, sheep, and fruits. Prayers were offered up, and hymns sung at their religious services. Human sacrifices were not practised by them, except among some frontier tribes, who adopted the practice from foreign races, and even in their case the practice was not continued long.

SLAVONIA (German, *Slavonien* or *Slavonien*), a division of the Austrian Empire, belonging to the Hungarian half of the dual monarchy, and now united into one administrative division with Croatia. Slavonia proper is bounded north and east by Hungary, south by Bosnia and part of Serbia, and west by Croatia; area, 3643 square miles. As the frontier districts, formerly part of the Military Frontiers, were provincialized in 1873, and annexed to the division of Croatia and Slavonia, Slavonia proper may be considered to have been increased by the addition of the districts of Gradiska, Brod, and Peterwardein, which are those which geographically belong to it. The total area of these districts is 2920 square miles, so that the total area of Slavonia, including them, is 6563 square miles. A branch of the Carnian Alps, entering Slavonia from Croatia on the west, traverses it throughout its whole length, forming the watershed between the Drave, a large tributary of the Danube, on the north, and the Save, another large tributary, on the south, sending down numerous small streams into each. These mountains, which are almost entirely composed of limestone, intersected occasionally by serpentine and porphyry, are neither very lofty nor very rugged, though they frequently terminate in sharp-pointed peaks. They are generally covered up to their summits with magnificent wood. On either side the mountains slope down rapidly, and give place to a succession first of lower hills and valleys, presenting a beautifully undulating surface, clothed with verdure or covered with orchards, and then of plains which extend without interruption to the banks of the rivers, in some parts inundated twice and thrice a year. The tracts thus exposed form belts along the Save and the Drave of several miles in width, and being covered with verdure form meadows on which large herds of horses, cattle, and swine are reared. The bee culture is also extensive. The soil is almost throughout of remarkable fertility. Grain, fruit (peaches, chestnuts, almonds, figs), flax, hemp, tobacco, liquorice, silkworms, wine, and excellent truffles are extensively raised. The minerals, understood to be important, are worked only to a very limited extent. They include several mines of copper and argentiferous lead, abundance of iron, and exhaustless supplies of beautiful marble. Slavonia has hitherto owed much more to the bounty of nature than to the industry of its inhabitants, who are generally very ignorant, and if not indolent, restless, and of unsettled habits. There are no manufactures deserving of the name; but the transit trade along the navigable rivers within which the country lies inclosed is considerable. The chief industry is the distillation (from plums) of *slivovitz*. The principal exports are fat cattle and swine; corn, chiefly wheat and rye; hides and skins, including those of foxes, wolves, and bears; tobacco, madder, liquorice, caviar, honey, and wax. The principal imports are iron, salt, and oil. Slavonia is the only country which has preserved the name of the great Slavonian stock. The inhabitants, the majority of whom are of the same race with the Servians, call their country *Slavonska* and themselves *Slavonatz*. They belong chiefly to the Non-united Greek Church; the remainder are mostly Roman Catholics. The language spoken by them is the Servian, or Servian-Croatian. The capital is Eszek.

Slavonia came in the reign of Augustus, as part of Illyricum, into the hands of the Romans. It belonged to the province of Pannonia, and from the river Sava was called Pannonia Savia. At the division of the empire it fell to the eastern portion, and remained under Byzantine rule till the time of the migration of nations in the fifth and sixth centuries, when all except Symria, the eastern portion of the district inclosed by the Drave, Sava, and Danube, fell away. Christianity was not effectively introduced into Slavonia till the latter part of the ninth century, when Cyril and Methodius laboured as missionaries there. At the time of the separation from the Eastern Empire Slavonia and Croatia formed one state, which was governed by its own rulers till the eleventh century, when it was joined to the Hungarian crown. Even after that it had separate rulers, chosen from the reigning family of Hungary. Stephen III. of Hungary (1161-74) was obliged to surrender Slavonia to the Byzantine emperor; but under his successor, Bela III. (1174-96), who was entirely devoted to the Byzantine court, it was restored to Hungary, and was governed by its own princes (*ban's*), sometimes also by scions of the royal family of Hungary. In 1442 began the wars with the Turks, who repeatedly laid waste Slavonia. In 1524 the part of Slavonia now bearing that name fell completely under the power of the Turks; but two years later, after the battle of Mohacs, its remaining three counties, Agram, Kreutz, and Warasdin, came under Austrian rule, and were henceforth called Croatia. Slavonia remained under Turkish sway till 1683, when it was wrested from them, after fifteen years of sanguinary wars, by Leopold I. The possession of the territory was secured to Austria by the Peace of Karlowitz in 1699. On coming into the hands of Austria it received a military organization for the defence of the Austrian frontier against the Turks, and this was maintained in its entirety till 1745, when part of it was placed under civil administration. The remainder continued to have a military organization till the date already mentioned, August 1, 1873. Pop. of Slavonia, in the more limited application, 381,480; of the frontier districts, 246,901; total pop. 628,381.

**SLEAFORD**, a market-town in England, in the county of Lincoln, 17 miles south by east of the city of Lincoln. It has a handsome and spacious church of the thirteenth century. There are ruins of the former castle of the bishops of Lincoln. Pop. of urban district (1891), 4655; (1901), 5468.

**SLEEP**, the name given in physiology to the state in which the activity of the senses and cerebrum or brain proper appears to be naturally and temporarily suspended. This state is consistent with a kind of passive activity of these nervous centres, as seen in the acts or phenomena of dreaming, as well as in other concomitant phenomena of sleep. Deep sleep of a dreamless kind most nearly approaches in character to the state denominated *coma* or *insensibility*; but it differs from the latter condition in that external or internal impressions of a strong or unusual nature (as, for example, the previous fixing of the hour of awakening) may cause its cessation. Sleep is the resultant probably of the combined waste of the nervous and muscular tissues. The nervous centres alone demand the rest of sleep, in virtue of the fact that the exercise of their functions is eminently destructive of their substance; whilst the rest of sleep acts in itself as a restorative by the temporary annihilation or suspension of these functions. In the so-called dreamless sleep the mind is presumed by some physiologists to be altogether inactive, although by others the mind is regarded as being ever active, and that in the

deepest sleep dreams occur, although we may be unable to recall them. In the induction of sleep at a periodical hour or time the influence of habit is well seen; and sooner or later the brain, when pushed beyond its usual period of activity, gives way to the natural impulse and demand for sleep. And this same habit corresponds in a marked degree with the surrounding impressions of the sleeper, as is well seen in the case of those accustomed to sleep amid noisy surroundings, and who, when removed to quiet resting-places, cannot for a time readily fall asleep amid their quieter surroundings. The respective influences of habit, age, temperament, and occupation have much to do with the induction and maintenance of sleep in different individuals. Habit affects the sleeper, as just noted, in accordance with his physical surroundings, and with those of his mental life as well. As to age, the infant repeats in its first days of life much of its previous life *in utero*. Sleep in this view becomes related to the phenomena of nutrition and growth, in providing a period when the process of growth may have the favourable balance in its favour afforded by the total suspension of physical loss and activity. The sleep of children is more profound than that of adults, but as age advances it becomes less so, and the individual consumes less time in sleep than before. Whilst in old age the conditions of youth and childhood again come into play, and afford in the greater amount of sleep of the aged the means whereby the frail frame is more easily recruited and less readily wasted. The temperament affects the sleeping habits of individuals in that those of lively active temperament sleep less profoundly, and take comparatively little sleep as compared with those of plethoric habits. The question of occupation and previous exhaustion bears of course an intimate relationship to that of habit, in that the latter condition modifies the otherwise easily estimated results of the bodily or mental work upon the sleep. The amount of mental exertion probably counts as the chief element in inducing sleep, whilst mere physical exertion necessarily, but in a secondary manner, reacts upon the brain. Yet some of the most acute and unwearied thinkers have been known to accustom themselves to take a very small amount of sleep, and one utterly disproportioned to their mental fatigue. Physiologists are all agreed that the dreamless sleep is the most refreshing, the lighter sleeper being liable to be disturbed by the most trifling noises. In some cases of diseased conditions sleep may be prolonged for indefinite periods, although obviously the distinction between *coma* and sleep is only made with great difficulty in such cases; whilst, on the contrary, periods of active wakefulness may occur and extend for a time much beyond usual, without a single interval of sleep or repose. The causes or *rationale* of sleep form subjects concerning which much discussion still exists amongst physiologists. The theory most commonly received is that which regards sleep as induced by changes in the circulation of blood within the brain, a fuller circulation being thus believed to induce a kind of normal and natural *coma*. Nothing definite can be said regarding the etiology of sleep and its analogous conditions, but recent research points to interaction between the nerve-centres, and the intimate blood-circulation through these centres, as the probable seat and cause of the phenomena we know under the name of sleep.

**SLESVIG**. See **SCHLESWIG-HOLSTEIN**.

**SLIDE-REST**, a contrivance adjusted to lathes and turning machines with the object of keeping the cutting tool properly applied to what is being turned, and sometimes also of moving the tool parallel to the axis of the turning-lathe. In the former case the

rest slides backwards and forwards at right angles to the axis of the lathe. A rest of the latter kind is necessary in turning screws, the rest being made to move regularly forwards, so as to make the point of the cutting instrument move at a certain angle round the piece that is being turned. The rest may either be moved by the hand or by a self-acting mechanical apparatus.

**SLIDING-RULE**, an instrument for performing various mathematical operations in a mechanical way. It consists of two graduated and numbered pieces of wood or other material, one of which slides in a groove in the other. All that has to be done in order to obtain the result of any of the operations that the instrument is calculated to perform is to adjust the one scale to the other according to certain rules depending on the nature of the operation. The instrument is used in measuring surfaces and solids, in gauging, the mensuration of timber, &c.

**SLIDING-SCALE**. See **CORN-LAWS**.

**SLIGO**, a maritime county in the north-west of Ireland, in the province of Connaught, bounded on the north by the Atlantic, east by Leitrim, south by Roscommon and Mayo, and west by Mayo; area, 462,145 acres, of which about 128,000 are waste, whilst rather more than one-half is pasture. The coast-line, in some places very rugged, is deeply indented by Killala and Sligo Bays, the former between it and Mayo. A large portion of the county is rough, hilly, and boggy, but it contains a considerable extent of very good land, though a good deal of the arable soil is very indifferent, being a light sandy loam. A great portion of the county is occupied by the formations of the Carboniferous Limestone group. Copper and lead mines were formerly, but are now no longer wrought. The principal rivers are the Sligo, Arrow, Owenmore, Esky, Moy, &c. There are also several lakes, having an aggregate area of 12,000 acres, and including the beautiful Lough Gill. The principal crops are oats and potatoes. The grazing farmers in this county are generally men of more capital than the tillage farmers, but the pasture-land is commonly rather poor. Some coarse woollens and linens are made. The county returns two members to Parliament, the divisions being the North and the South. Sligo is the capital; Ballymote and Tobercurry are villages. Part of the town of Ballina is in this county, but the larger portion belongs to Mayo. Pop. in 1881, 111,576; in 1891, 98,013; in 1901, 84,022.

**SLIGO**, a seaport town and former parliamentary borough (till 1870) of Ireland, capital of county Sligo, near the mouth of the Garavogue in Sligo Bay, 110 miles north-west of Dublin. The river is here spanned by two plain bridges. The town has two Protestant Episcopal churches, a Roman Catholic cathedral, a new abbey, a friary church, and chapels for Independents, Presbyterians, and Wesleyans; ruins of an interesting abbey of the fifteenth century; a town-hall, including exchange, chamber of commerce, free library, borough court, assembly-room, &c.; new assize courts; a model national school; barracks; prison; hospital; lunatic-asylum, and workhouse; a brewery, corn-mills, saw-mills, &c.; an export trade with Liverpool and Glasgow in cattle and agricultural produce; and periodical markets for butter, grain, &c. The harbour has been recently improved and deepened. Pop. (1891), 10,274; (1901), 10,862.

**SLING**. The sling was a very general instrument of war among the nations of antiquity, but it is not mentioned in the *Iliad*. The people of the Balearic Islands excelled at the sling, and were much employed in the armies of the Romans and Carthaginians. Livy mentions some tribes still more dex-

terous than these islanders, who discharged stones with so much force that neither buckler nor head-piece could resist them, and who hit their mark to a hair-breadth. In the book of Judges (ch. xx.) it is recorded that in the town of Gibeah, in the tribe of Benjamin, there were 700 chosen men, left-handed, every one of whom could sling stones at an hair-breadth and not miss.

**SLIP**, in a dockyard, the inclined plane on which a ship is built, and from which it is launched. The usual inclination is about 1 in 19. The foundation of a slip must be very solid. A slip for repairing ships is laid with rails running down into the water. A number of small carriages or trucks may be let down or hauled up these rails, and several of them may be combined in such a manner as to form a single large carriage suited to the size of the vessel to be drawn up. The carriage is let down below the keel of the vessel when the water is high enough to allow the latter to float, and when the tide has ebbed so that the vessel rests on the carriage it is drawn up by steam-power.

**SLIPS, PROPAGATION BY**, a mode of propagating plants which consists in separating a young branch from the parent stock, and planting it in the ground. There are trees of which slips take root very readily. In general those of which the wood is white and light succeed best. Thus, a slip of willow, poplar, or lime, on being stuck in the ground, takes root there in a short time, and soon shoots up vigorously. A slip succeeds more certainly when two or three young buds are left upon the lower part of it underground. These buds then become elongated into roots. Some species, such as pines, oaks, heaths, and in general trees with very dense or resinous wood, are difficult to propagate by slips.

**SLIVNO**. See **SELMINO**.

**SLOANE**, SIR HANS, a distinguished naturalist, and founder of the British Museum, was born at Killileagh, county Down, on April 16, 1660, and studied medicine in London, Paris, and Montpellier. In 1684 he settled in London for the practice of his profession, and in 1685 was admitted a fellow of the Royal Society, of which he was appointed secretary in 1693, and president in 1727. His *Voyage to the Islands of Madera, Barbados, Nieves, St. Christopher's, and Jamaica*, with the *Natural History of the Last (1707-25)* was the result of observations made in the West Indies during his stay as physician to the governor in 1687-89. George I. created him a baronet and physician-general to the forces in 1716, and on the accession of George II. he was named physician in ordinary to his majesty. His death took place at Chelsea on the 11th of January, 1753. See **BRITISH MUSEUM**.

**SLOBODSK**, or **SLOBODSKOI**, a town in Russia, in the government of Viatka, on the right bank of the river Viatka, and 18 miles north-east of the town of Viatka. It has manufactures of leather, matches, and gloves, and there are bell-foundries and an important trade in corn, linseed, &c., with Archangel. Pop. (1893), 7758.

**SLOE**, or **BLACKTHORN** (*Prunus spinosa*), a well-known deciduous shrub of the plum genus, if not indeed of the same species (see **PLUM**), with spinose branches, and possessing a very hard tough wood. It blossoms with small white flowers in early spring, before the leaves expand, and has a black round austere fruit (of the size of a very large pea) which is used for preserves, sometimes for making a fictitious port wine or for mixing with port, and for dyeing black. The bark has tonic and astringent properties, and the leaves are sometimes used to adulterate tea. The sloe abounds in Britain and in most parts of Europe, growing in hedges, coppices, &c., and is from

4 or 5 to 15 or even 20 feet high. There are several varieties, including double-flowered, variegated-leaved, and egg-shaped-fruited forms. Some of these are cultivated in shrubberies, gardens, &c., as ornamental plants.

**SLONIM**, a town in Russia, in the government of Grodno, and 70 miles south-east of the town of Grodno. It is walled, and has an old castle, and a trade in grain and leather. Pop. (1894), 25,739.

**SLOOP**, in naval affairs, a small vessel furnished with one mast and a fixed bowsprit. It is fore-and-aft rigged, and usually carries a main-sail, fore-sail (jib-shaped), a jib, and a gaff-sail. It is a common rig for yachts. Sloops of war used to be vessels commanded by officers of a middle rank between a lieutenant and captain, styled *masters* and *commanders*. They were variously rigged as ships, brigs, schooners, and sometimes cutters.

**SLOTH**, the name applied to various genera of Edentate Mammalia. (See EDENTATA.) Of these the best known are the Unau or Two-toed Sloth of the West Indies, the *Cholepus didactylus* of naturalists; and the Ai or Three-toed Sloth (*Bradypus tri-dactylus*) of South America. The Sloths form the family Bradypodidae of the order Edentata, this family being distinguished by the flat short head, and by the elongated legs, furnished with powerful claws of compressed and curved shape. No incisor-teeth exist, but simple molars are developed. In the Unau the first tooth of each side of either jaw is larger than the others, and is by some naturalists regarded as a canine. The stomach is of somewhat complex nature. The three-toed species has more than the ordinary mammalian number (seven) of cervical vertebrae. The long bones are solid, and destitute of marrow or medullary cavities. Being adapted solely for an arboreal life, the fore-limbs exhibit a greater length than the hind-limbs, and a powerful muscular organization. The fore-arm possesses an unusual degree of mobility, the feet being strong and the claws very powerful. The usual mode of progression of these animals is to move back downwards suspended from the branches of trees, and they are known to sleep in this curious position. On the ground the Sloths are entirely out of their element; the feet being jointed in an oblique manner to the limbs, the palms and soles are thus naturally turned inwards, and the claws themselves are bent inwards towards the soles of the feet. The toes are further imbedded in the skin, so as to leave the claws alone free. On the ground, therefore, the Sloths appear as if affected with 'club-feet,' and terrestrial progression becomes both awkward and painful; but placed in their natural habitat amid the trees, the curved and inwardly-disposed claws and limbs are seen to be admirably adapted for locomotion in their characteristic fashion through their native forests. Sixteen pairs of ribs are developed in the Ai, and this species possesses rootless molar teeth, which grow from persistent pulps. Three toes exist in the latter species, and its general colour is a brownish gray, with darker tints on the face and limbs. The fur is of very coarse character. The Unau, as its specific name implies, has but two toes, and twenty-three pairs of ribs exist, no Mammal possessing a greater number than this. Its average length is about 2 feet, and its colour is a lighter gray than that of the Ai. The tail in both species is either wanting, or at the most is of rudimentary character. No Sloth develops the bony plates seen in the nearly-allied Armadillo (which see).

**SLOTING MACHINE**, a machine for cutting out slots or mortises in metal. A chisel held firmly in an arm of the machine moves vertically, and at every descent is driven forcibly down on the metal.

**SLOUGH**, a town of England, in Buckinghamshire, 20 miles W. of London, and 3 miles N.W. of Windsor. At Slough Sir William Herschel erected his large astronomical telescope, and made some of his most important discoveries. Pop. of urban district, in 1891, 8713; in 1901, 11,461.

**SLOVAKS**, the name of the Slavonian inhabitants of Northern Hungary. They are the descendants of the Slaves that settled on the south of the Carpathians between the Danube and the Theiss, where they maintained themselves for centuries, and in the ninth century formed the nucleus of the great Moravian Empire. After the battle of Presburg, in 907, in which this empire was overthrown by the Magyars, the Slovaks gradually fell under the yoke of the conquerors. At the present day they are scattered over most of the counties of Hungary, and in the north-western counties they form the majority of the inhabitants. They are also found in Moravia in the districts adjoining Hungary, and in detached settlements in Lower Austria, Bukovina, and Slavonia. The Slovaks possess in their own dialect a number of beautiful popular songs, collections of which have been published at different times (Penth, two vols. 1823-27; Ofen, two vols. 1834). (See SLAVES—Slavonic Literary Dialects.) The total number of Slovaks is about 2,000,000.

**SLOVENIANS**, the native name of some Slavonian tribes in Styria, Carinthia, Carniola, the Austrian maritime territory, in a narrow strip in the west of Hungary, and in Venetian Friuli. By the Germans they are often called Wends or Winda, and in learned works sometimes Korutanians. They settled in these districts towards the end of the sixth century, having migrated there from Pannonia. Christianity was introduced among them not later than the eighth century. Their land was incorporated under the name of the Windic March with the empire of Charlemagne. Out of this march were afterwards formed the Duchies of Styria, Carinthia, and Carniola, which fell to Germany and ultimately to Austria. Their total number is about 1,200,000. The language of the Slovenians is closely allied to the Servian. (See SLAVES—Slavonic Literary Dialects.) It possesses some very old and valuable monuments of the Slavonic tongue. The oldest, which is at the same time the most ancient of all the Slavonic literary relics, is the Munich manuscript, of the date 957-994, written by Bishop Abraham of Freysing in Bavaria, and consisting of three pieces on religious subjects. It is printed in Kopitar's *Glagolita Clozianus* (Vienna, 1836). After a long slumber the dialect was resuscitated for literary purposes in the sixteenth century, when several ecclesiastics brought it to a high state of development. In 1584 Bohoric published a grammar of the language, and in the same year there appeared in it a translation of the whole Bible. The best grammar is that of Kopitar (Laibach, 1808). A dictionary by Jarnik and Mark was published in 1832, and collections of popular songs were published by Wraz and by Korytko in 1839.

**SLOW-MATCH**, a match made so as to burn very slowly. The commonest kind of slow-match is a piece of slightly-twisted hemp rope dipped in a solution of saltpetre, sugar of lead, or something else that will serve the same purpose. Tightly twisted cotton rope, without any further preparation, will do equally well. Slow-matches are chiefly used to fire mines or blasts, the object of using them being to allow the person who fires them to escape to a safe distance before the explosion takes place.

**SLOW-WORM**. See BLIND-WORM.

**SLUG**, the name applied to several genera of Gasteropodous Mollusca, included in the Pulmonif-

erous (or 'Lung-bearing') section of the class, and in the group Inoperculate of the latter division. The typical Slugs form the family Limacidae, and possess a rudimentary shell, internal in its nature, and generally concealed more or less completely by the mantle. The three genera *Limax*, *Arion*, and *Testacella* include the best-known species. In the genus *Limax* the shell is internal and of oblong shape, the foot is very long, and the head and tentacles are retractile. Of this genus the Great Gray Slug (*Limax antiquorum*), the largest British species, and the Black Slug (*L. ater*) are the two familiar species. The former is of nocturnal habits and gray colour, and may attain a great relative size. It usually frequents hollow trees, undisturbed heaps of decaying vegetable matter, and like situations. The Black Slug is more common than the gray species, and is usually of smaller size. The genus *Arion*, represented by the Red Slug or Land Sole (*A. rufus*), is distinguished from *Limax* by its oval shell and its rounded tail, which is glandular at its tip. The colour is deep brown or reddish. The genus *Testacella* is distinguished by the small ear-shaped shell situated at the extremity of the body, whilst the back exhibits a double furrow, with lesser grooves branching from it. This genus, of which three species exist, is represented by the little carnivorous *Testacella haliotoides*, which feeds chiefly upon earth-worms, and is generally found in the loose soil of gardens. The odontophore (which see) or tooth-ribbon of this species is very long, and well provided with silicious or flinty teeth, by means of which it makes war on its prey.

**SLUR**, a sign in the form of a curve, placed over two or more notes on different degrees, to indicate that they are to be played *legato*. In vocal music it signifies that the notes over which the sign is placed are to be sung to the same syllable. When there are two notes on the same degree with such a sign placed over them, the sign is called a tie, and it indicates that both notes are not to be sounded, but that one is to be played of the length of both.

**SMACK**, a small vessel rigged as a cutter, sloop, or yawl, used in the coasting trade and in fishing. The old Leith smacks, carrying passengers, attained the size of 200 tons.

**SMALKALDIC LEAGUE**. See **SCHMALKALDEN**.

**SMALL-ARMS**, a general name for all portable weapons. (See **BAYONET**, **MUSKET**, **RIFLE**, **REVOLVER**, &c.) The small-arms factories at Enfield and Birmingham each employ between three and four thousand men. They manufacture rifles, machine-guns, carbines, revolvers, bayonets, sabres, swords, and lances for the British army. Occasionally orders for arms, especially machine-guns, are placed with private firms as well. Until the time of the Russian war the production at Enfield was comparatively small, all the weapons being made by the hand; but when that war caused the insufficiency of this mode of production to be felt, the manufactory was completely remodelled. Machinery was introduced capable of turning out 1000 rifles daily. The different parts of the rifles are made so accurately on the same model that a part belonging to any one of the rifles manufactured there will do equally well for any other.

**SMALL-POX**, an eruptive fever, which, in its pustules, engenders an infectious matter, by means of which the disease may be communicated to other persons who have not been before attacked by it. After the infection has taken place, about seven days pass before the virus operates and produces the disease. Then a feverish shivering pervades the body, which regularly lasts about three days; after which a number of red spots appear, first in the face,

then over the breast, hands, and the whole body, sometimes very numerous, sometimes in a small number. This eruption also lasts about three days. From the spots rise pustules, which become inflamed and suppurate. The fever in the meantime continues without intermission. After the suppuration the pustules begin to dry up, and to form a crust, a change which generally commences about the eleventh day. Commonly the small-pox virus infects but once. A person who has had the small-pox very rarely has it again; nor does this virus infect at all times; on the contrary, it seems that a person must have a certain susceptibility for it; for numerous instances have occurred in small-pox epidemics of persons being spared who became infected at a later period, and even of some who have escaped during their whole life. The first mention of this disease is found in Arabic writers. Masudi relates that it attacked the Abyssinians besieging Mecca about A.D. 570. The Syrian physician Aron about 622 describes it as a well-known disease, and Rhazes about 922 wrote the first monograph upon it, and in this essay he classes it with the measles. Whether the disease was introduced into Europe by the Arabs or not cannot be determined with certainty; but it is undoubted that from the thirteenth century downwards, until a check was put upon its ravages by the introduction of vaccination, it raged unceasingly with great destructiveness among all the nations of the West. It appears to have been introduced from Europe into America, where it committed terrible havoc among the natives. Whenever it appears in a country for the first time it is more fatal, and makes greater ravages than after having prevailed for some time, as it did in Iceland in 1707, and in Greenland in 1733. As this disease is propagated only by infection it has been thought possible to extirpate it by the strict separation of the infected from the healthy. The obstacles, however, arising from the present situation of nations, and the general diffusion of the disease in all countries and climates, seem to render such a plan impracticable. The violence of the disorder, however, is lessened when it is produced artificially by inoculation with the small-pox virus. Inoculation had long been practised in Turkey, especially among females, for the preservation of the beauty of young girls, when the celebrated Lady Montagu introduced it into Western Europe. In Constantinople, whether she had accompanied her husband, she caused her son six years old to be inoculated, and after her return to England in 1722 her daughter also. From that time inoculation became common in England, notwithstanding the opposition of many physicians, and afterwards in other countries; but never became universal, because many prejudices were entertained against it, and because the disease, although mitigated, is yet not quite without danger. Latterly inoculation has been entirely superseded by vaccination, which is far more safe. See **INOCULATION**, **VACCINATION**.

**SMALL-POX**, in sheep, a very formidable disease long known on the Continent, but rare in Great Britain, and indeed said to have been unheard of there till 1847, when sheep and cattle were allowed to be imported by act of Parliament. Its first appearance in Great Britain was due to certain Merino sheep imported in July, 1847, in several vessels, and sold at Smithfield. The disease appears to have raged mostly in the eastern counties of England (Lincolnshire and Norfolk especially), and those in the vicinity of the metropolis. The destruction in some cases amounted to 95 per cent. The symptoms are a dull and moping appearance, with dulness of eyes and swelling of eyelids, succeeded by reddish spots in the naked places. In a few days what is called the

popular stage commences; swellings resembling fleabites appear, varying in size from  $\frac{1}{4}$  of an inch to 1 inch in diameter; in mild cases, moderately red and circumscribed; in severe cases, of a purple hue, and sometimes running into each other. There are thus two kinds of the disease, the distinct and the confluent; the latter is always most severe. The greater number of deaths occurred in the early stage of the disease, and when it was very rife in a flock the sheep died off without any external manifestations, as if they were poisoned. If they lived over this stage they were still in great danger of dying in the third. The disease was greatly increased by exposure to wet, which appeared to accelerate its mortality. Vaccination was tried as a preventive measure, but without success. Inoculation seems to have shown more satisfactory results, but the best preventive has been found to be a strict watch on the part of veterinary inspectors appointed by the government to prevent the importation of diseased sheep.

**SMALT.** In the sixteenth century a Bohemian glass-blower, Schürer by name, discovered that cobalt salts have the power of imparting a beautiful blue colour to glass. The production of the substance called smalt dates from this discovery. Smalt is prepared by fusing together quartzose sand, carbonate of potash, and roasted cobalt ore in crucibles placed in a glass furnace; throwing the hot glass into water, and pulverizing and sorting the blue powder thus formed. In the process of fusion the nickel, iron, and copper sink to the bottom of the crucible in the form of arsenides and sulphides, producing the substance known as *species*, while the glass enters into combination with the oxide of cobalt and floats on the surface in a molten state. Smalt is a silicate of cobalt and potassium, and generally contains varying amounts of alumina, iron, lime, and nickel oxide.

**SMEATON, JOHN**, an eminent civil engineer, was born May 28, 1724, at Austerhorpe, near Leeds. His father was an attorney, and being desirous to bring up his son to the same profession, he took him to London in 1742, where he attended the courts in Westminster Hall; but after some time, finding that the law was not suited to his disposition, he wrote a strong memorial to his father on the subject, who immediately desired the young man to follow the bent of his inclination. In 1751 he began a course of experiments to try a machine of his own invention, to measure a ship's way at sea, and made two voyages in company with Dr. Knight to try the effect of it, and also for the purpose of making experiments on a compass of his own construction, which was rendered magnetical by Dr. Knight's artificial magnet. In 1753 he was elected a fellow of the Royal Society, and a number of papers which he published in their Transactions show how highly he deserved the honour. In 1755 the Eddystone lighthouse was burned down, and Smeaton was intrusted with the task of rebuilding it. Operations were commenced in August, 1756, and were completed in October, 1759. It stood till 1882, when it was replaced by a new structure. In the year in which the lighthouse was finished he was awarded the Copley medal of the Royal Society. After this Smeaton was employed on many works of great public utility. He made the river Calder (in Yorkshire) navigable—a work that required much skill, owing to the impetuous floods in that river; and planned and attended to the execution of the Forth and Clyde Canal in Scotland, constituting a convenient waterway for traffic passing between the Atlantic and the German Ocean. He was appointed engineer to Ramsgate harbour, and improved it by various operations, of which he published an account in 1791. He constructed a variety of mills,

built a steam-engine at Austerhorpe, and made a vast number of experiments with it to ascertain the power of Newcomen's engine (see **STEAM-ENGINE**), which he improved and brought to a far greater degree of perfection, both in its construction and powers, than it had before. During many years of his life he was a frequent attendant upon Parliament, his opinion on various works begun or projected being continually called for. He died near Leeds on the 28th of October, 1792. Smeaton was fond of science for its own sake, and spent much of his leisure in the study of astronomy, for which purpose he fitted up an observatory in his house, furnished with curious contrivances of his own invention. He was a friend and encourager of merit wherever he discerned it, and many persons were indebted to him for important assistance on entrance into life. Smeaton was the institutor, in 1771, of a society of civil engineers, which was dissolved at his death, but afterwards renewed. They published in 1797 a volume of his Reports.

**SMELL**, the sense exercised in the perception of odours, through the functions of the olfactory nerves. The sense is one of the special senses (see **SENSATION**) in that the nerves devoted to the appreciation of odours exercise that function alone, and are not affected by any other kind of impressions; whilst again, no nerves are capable of receiving the particular impressions of odours but the olfactory filaments. The exact *rationale* of the exercise of the sense of smell is as yet not perfectly understood. It may be the result of a peculiar state or condition of the olfactory nerve, or of some change induced in the nerve through contact with odorous particles. That the presence of matter in the form of particles is usually necessary for the exercise of this sense is an indisputable fact. Particles suspended in air—or water in the case of aquatic forms—and matters in the form of gaseous 'particles,' the latter undoubtedly of less material nature than particles of solid matter, are thus brought in contact with the olfactory nerves, and produce or give the impressions of smell. It would appear, however, that matters must undergo a certain amount of solution in the mucus or characteristic secretion of the mucous membrane of the nostrils before special impressions can be produced; and the moist condition of the nasal cavities therefore forms an essential feature for the due exercise of this sense. The necessity of this condition is well seen in cases where the 'Schneiderian membrane,' or that of the nostrils, is so affected (as in catarrh or cold), that it becomes hot and dry, the sense of smell becoming, as is well known, either greatly impaired or totally lost in such cases. The matters giving the odorous impressions also require to be sent through the nostrils in currents, and with some degree of force; as is well seen in the act of smelling, when the mouth is closed, and the odours are sniffed rapidly into the nose. The *voluntary* nature of the act of smelling is also thus exemplified, since by interrupting the respiration or breathing, the sense cannot be duly exercised. The extreme minuteness of the particles of matter concerned in smell may be illustrated by examples of the property of matter known to physicists as *indivisibility* (which see). Suppose, for instance, what daily experience teaches us is possible, that, with a portion of oil of lavender only one line square, we perfume a chamber 18 feet long, as many broad, and 10 feet high, and containing 3240 cubic feet, or 486,560 cubic lines, and suppose, moreover, that in each cubic line there are floating but four of the odiferous particles, we shall then find that one cubic line of oil may be divided into 1,866,240 odiferous particles. If a piece of ambergris,

weighing 100 grains, is left upon a balance which is sensible to the smallest part of a grain, in an open chamber, notwithstanding there is free draught of air from without, the chamber is filled with the odoriferous particles; and yet, at the end of five and a half days, not the smallest diminution of the ambergris is perceptible; from which fact the extreme fineness of the effluvia may be inferred. And similarly a grain of musk will perfume a chamber for years, necessarily giving off all the while minute particles of its substance, without exhibiting, when weighed, any appreciable diminution in weight. The structure of the nasal cavities and the distribution and peculiarities of the olfactory nerves have been already described in the article *NOSE* (which see). It therefore only remains in the present instance to note some of the more prominent conditions which are essential to the performance of this function. The olfactory nerves form the *first pair* of cranial nerves, or those given off directly from the brain as a centre. (See *NERVE*.) Each nerve is triangular in shape, and runs forwards on the base of the brain, to terminate in the *olfactory ganglion*—an olive-shaped body, of reddish-gray colour, which lies on the cribriform plate of the ethmoid bone. From the under surface of the ganglion the olfactory nerves, numbering about twenty on each side and supplying the nose, are given off. These filaments are distributed to the membrane of the nostrils, their terminations coming into communication with specially-modified cells in the membrane. The cavities of the skull in connection with the nostrils appear to exercise little or no influence on the sense of smell. Thus, substances injected into the frontal sinuses give no impressions of odours. The nasal cavities, in addition to their special sense furnished by the olfactory nerves, are endowed with common sensibility by the filaments (nasal branches) of the first and second divisions of the fifth nerve. These latter filaments cause the sensations of pain, heat, itching, and other effects, perceived in the nostrils. But these filaments, it is to be noted, have no part in the function of smell. The appreciation of acrid or pungent smells is possible after the special sensations of smell have disappeared; but this is not a true olfactory sensation. It is not due, that is to say, to stimulation of the olfactory terminal organs, but to stimulation by the pungent substance of the nerves of common sensibility. Thus, the excitation of the nostril by the vapour of ammonia is owing to stimulation of the fifth nerve. The facility with which different odours are perceived varies in different animals. Thus, Carnivorous Mammalia are most susceptible to the odours of other animals than herbivorous forms, and the latter in their turn are more readily affected by the smell of plants. Although the sense of smell in man is less acute with regard to many special substances than that of many of the lower animals, yet his olfactory sense exercises its function over a wider range of subjects, and his susceptibility to odours is far more diffused than that of other forms. The influence of *habit* is very marked in the exercise of this sense, custom enabling the individual to inhale odours which at first might be distasteful or nauseous to him. Then also there appear to be special susceptibilities evinced in some cases to the odour of certain substances, and to the explanation of the latter, or indeed the former phenomena, physiology has as yet found no definite clue. When solutions of substances (such as sulphate of magnesia) which are themselves inodorous are injected into the nostrils, no sensation of smell is produced. And certain diseases of the brain may produce anomalous effects on the olfactory sense. Thus, a constant sensation of a disagreeable odour was present in a man who was

found to have laboured under disease of the arachnoid membrane (see *MENINGES*) of the brain.

**SMELLIE, WILLIAM**, a celebrated naturalist and general writer, born at Edinburgh in 1740; died there June 24, 1795. He was of humble parentage, and after completing his school education he was apprenticed to a printing firm, in connection with which he worked as a compositor and corrector of the press. While thus engaged he attended classes at the university. In 1766 he commenced business as a printer on his own account in conjunction with a Mr. Auld. One of Mr. Smellie's first literary efforts of importance was the compiling and conducting of the first editions of the *Encyclopædia Britannica*, which began to be published in numbers at Edinburgh in 1771, and was completed in three vols. quarto. In 1780 he gave to the world the first part of his *Translation of Buffon's Natural History*, a work which deservedly acquired a high reputation, and gave great satisfaction to the eminent French naturalist himself. About this time also he originated the scheme, afterwards carried out by Sir John Sinclair, of compiling a *Statistical Account of Scotland*, from the information furnished by the ministers of the respective parishes. Throughout life Smellie had been an ardent student of natural history, and a series of treatises had also been composed by him on various subjects relating to natural history, including a course of lectures, which, however, were never delivered. These essays in a collected and emended form were at last published under the title of the *Philosophy of Natural History*, a well-known work, the first volume of which appeared in 1790, and procured the author the sum of 1000 guineas for the copyright. The second volume was not published until 1799, four years after his death. *Memoirs of Lord Kames*, Dr. John Gregory, and David Hume, forming part of a projected larger work, were published after his death by his son. His other works were numerous and various in their character.

**SMELT** (*Osmerus Eperlanus*), a genus of fishes belonging to the family Salmonidæ. The body is slender, and somewhat compressed; the eyes large and round, and the under jaw longest. The European Smelt is 10 to 11 inches long; the head and body are semitransparent, with the most brilliant tints of green, and silvery. It has a strong odour, by many compared to that of violets. It inhabits the sea as well as the depths of those lakes which have a sandy bottom, and in the spring ascends rivers in great multitudes, for the purpose of depositing its spawn. It is highly esteemed as food owing to its delicate flavour. The American Smelt (*Osmerus mordax*) is considered a different species. It grows to the length of 10 inches. The name of Sand Smelt is given to the *Atherina presbyter*, a small fish belonging to the family Atherinidæ, and nearly allied to the Mulletts and the Climbing Perches. The Sand Smelt averages about 6 inches in length, its colour being a pale pink, relieved on the sides by silvery white, whilst the gill-covers, cheeks, and the bases of the pectoral fins are also white. The upper surface of the head and back are marked with black spots. This fish is most plentiful on the southern coasts of Britain, and is sought after chiefly for bait, but also as a food-fish. The flesh is very delicate.

**SMELTING.** See COPPER, IRON, LEAD, SILVER, &c.

**SMETHWICK**, an industrial town of England, in Staffordshire, a short distance to the north-west of Birmingham, and engaged in similar manufactures. It has engineering and machine shops, rivet, screw, and tube works, iron-foundries, chemical-works,

extensive glass-works, &c. Pop. (1891), 26,170; (1901), 54,689.

**SMEW** (*Mergellus albellus*), a genus of Natatorial or Swimming Birds, found in winter on the coasts, and in the ponds and lakes of Britain. It belongs to the sub-family Merginae, also represented by the Goosanders (*Mergus castor*) and Mergansers. The genus *Mergellus*, to which the Smew belongs, is distinguished by the bill being much shorter than the head, by its tip being broad and hooked, by the closely-toothed edges, and by the nostrils being situated near the middle of the bill. The Smew is of shy habits. It flies well, but has an awkward gait on land. The average length of the male is about 17 inches, the female being usually about 13 or 14 inches only in length. The colours of the male are white on the head, neck, and chin; a black patch exists at the base of the bill and surrounds each eye. The back of the head exhibits a greenish lustre, and is provided with a crest of elongated feathers, some of which are white. The back is of black colour, with a gray tail. The wings are of a mixed black and white colour, and the under parts are white. The plumage of the female is reddish brown mixed with gray tints. The food consists of crustacea and molluscs; and the eggs are of a brown colour, and number eight or ten. It is not known to breed in Britain.

**SMILACEÆ**, a natural order of monocotyledonous plants, now always regarded as a tribe of the Lily order (*Liliaceæ*). They are herbs or shrubby plants, often climbing; the leaves are petiolate and jointed to the stem; the flowers hermaphrodite or unisexual. The members of this order are scattered over all the temperate and tropical districts of the world except in Africa. The genus *Smilax* embraces the various species of sarsaparilla. The tubers of the *Smilax China*, a native of China and Japan, and of the *Roxburghia viridiflora*, a native of the Eastern Peninsula and the islands in the neighbourhood, are used for food; but those of the latter must first be boiled and soaked in lime-water to remove their acidity.

**SMIRKE, ROBERT**, an English painter, born near Carlisle in 1751 or 1752, was originally employed in painting coach panels, but soon proved himself capable of excelling in a much higher branch of the art; and before the appearance of Wilkie had no great rival as a *genre* painter. He was elected a member of the Royal Academy in 1792, the year when Sir Joshua Reynolds died, and gave as his presentation picture Don Quixote and Sancho. Cervantes indeed furnished him with his favourite subjects; and a large proportion of his pictures are admirable illustrations of the creation of Cervantes's pen. Among others may be mentioned Sancho's Audience of the Duchess, Don Quixote addressing his Princess Dulcinea, and the Combat between Don Quixote and the Giants interrupted by the Innkeeper. Among his other works a first place is due to his Infant Bacchus, Psyche, the Angel Justifying Providence, from Parnell's Hermit; the Gipsy, and the Fortune-tellers. He also furnished many designs for illustrated works, one of which was Boydell's Shakspeare. He died in London on the 5th of January, 1845.

**SMITH, ADAM**, a distinguished writer on political economy and on morals, was the only son of Adam Smith, controller of the customs at Kirkcaldy, where he was born June 5, 1723, a few months after the death of his father. He received his early education at the school of Kirkcaldy, whence he was removed at the age of fourteen to the University of Glasgow, where he remained until 1740, when he repaired to Balliol College, Oxford, as an exhibitor on Snell's

foundation. Quitting Oxford, and all views to the church, which had led him there, in 1748 he took up his abode at Edinburgh, and delivered some courses of lectures on rhetoric and polite literature, under the patronage of Lord Kames. In 1751 he obtained a more permanent provision by being elected professor of logic at Glasgow, and the year following, of moral philosophy at the same university. He was now in a situation which perfectly agreed with his talents and inclination, and both in matter and manner his lectures were of the highest merit. Those on moral philosophy contained the rudiments of two of his most celebrated publications, of which the first, entitled the Theory of Moral Sentiments, appeared in 1759, and was most favourably received. His theory makes sympathy the foundation of all our moral sentiments. To this work he afterwards added an Essay on the Origin of Languages; and the elegance and acuteness displayed in these treatises introduced him to the notice of several eminent persons, and among others to Mr. Charles Townsend, who engaged him in 1764 to attend the Duke of Buccleuch in his travels. A long residence in France with this nobleman introduced him to the acquaintance of Turgot, Quesnay, Necker, D'Alembert, Helvétius, and Marmontel, to several of whom he was recommended by David Hume. He returned to Scotland in 1766, and thereupon retired with his mother to Kirkcaldy, where he led a life of strict study and retirement for ten years, the fruit of which was his celebrated Inquiry into the Nature and Causes of the Wealth of Nations (two vols. 4to, 1776). It is unnecessary to say that this work has become a standard classic, and that it may be deemed the formal precursor of the modern science of political economy. (See POLITICAL ECONOMY.) About two years after the publication of this able production he obtained, through the patronage of the Duke of Buccleuch, the lucrative place of commissioner of the customs in Scotland, in consequence of which he removed with his mother, who attained a great age, to Edinburgh. In 1787 he was chosen rector of the University of Glasgow. Soon after his health began to decline, and he sunk under a chronic disease in July, 1790, at the age of sixty-seven. A short time before his death he ordered all his manuscripts to be burned, except a few detached essays. Adam Smith was a man of much simplicity of character, subject to absence of mind in society, and better fitted for speculation than action. He was at the same time much beloved by his friends for his kind and benignant disposition, and died generally admired and highly respected. Numerous editions both of the Moral Sentiments and the Wealth of Nations have been published. Of the former the sixth edition, published in the year of the author's death, contained considerable additions and corrections. This work was translated into French by the Marquis de Condorcet. A volume of additions and corrections to the first two editions of the Wealth of Nations appeared in 1784, and was included in the third edition, published in the same year. The best of the later editions of this standard work are those published under the editorship of J. Ramsay Macculloch (four vols., with life, notes, supplementary dissertations, &c., 1828; often reissued), J. E. Thorold Rogers (two vols., 1870), J. S. Nicholson (1884), and E. Belfort Bax (two vols., 1887). The Wealth of Nations has been translated into several European languages—into French by Germain Garnier (1802; new edition, 1860); into German by Garve (Breslau, 1794–96) and by Asher (Stuttgart, 1861). See the Life of Adam Smith by Dugald Stewart, and also Mackintosh's Progress of Ethical Science. A more recent life is that by Rae (1895).

**SMITH, ALBERT**, a well-known popular writer, was born at Chertsey, Surrey, on 24th May, 1816, and educated at Merchant Taylors' School. He studied medicine, became a member of the College of Surgeons in 1838, and commenced practice in partnership with his father in his native town. His inclinations, however, led him in a literary direction, one of his first Essays being *Jasper Buddle, or Confessions of a Dissecting-room Porter*, contributed to the *Medical Times*. Another scheme tried by him was a lecture on the Alps, with views of their scenery, which he delivered in most of the small towns in the neighbourhood of London during 1839 and 1840. Stimulated by success he took up his abode in London in 1841, and commenced the life of a literary man, contributing extensively to the magazines, producing numerous small works in the walks of light literature, and writing burlesques and other dramatic pieces for the stage. Among the various lucubrations given by him to the public may be mentioned *The Adventures of Mr. Ledbury*; *The Scattergood Family*; *The Marchioness of Brinvilliers*; *Christopher Tadpole*; *The Pottleton Legacy*; and a series of shilling books, extremely popular at the time, under the titles of *The Natural History of the Gent*, *The Natural History of the Ballet-girl*, *Stuck-up People*, *The Flirt*, *A Bowl of Punch*, and others. In estimating the intellectual ability of Albert Smith it must be admitted that his works belong to the very lightest class, which, nevertheless, are very acceptable in their proper place, as a relish after more solid reading. In 1849 he made a tour to the East, and on his return produced next year a panoramic entertainment entitled *The Overland Mail*, which he accompanied with a most amusing descriptive lecture. In the following year he visited the Continent, and having ascended Mont Blanc, turned this feat to account by making it the subject of a similar entertainment, produced at the Egyptian Hall in 1852. Its success was almost unprecedented, the lecturer netting from first to last upwards of £20,000—a result attributable both to the merits of the entertainment itself, and the admirable manner in which he provided for the comfort of his audience. After a lengthened period, during which the Ascent of Mont Blanc formed one of the most attractive sights of the metropolis, Smith set out in the autumn of 1858 for China, and after remaining there a short time returned and commenced a new pictorial-descriptive entertainment on the subject of the Flowery Land. This was not so successful as the popular Mont Blanc, which he resumed in the spring of 1860, and continued till within two days of his death, which was brought on by bronchitis, combined with congestion of the lungs, and which took place at North End Lodge, Fulham, on 22d May, 1860.

**SMITH, ALEXANDER**, poet and essayist, was born at Kilmarnock, 31st December, 1830. His father, who was a pattern-designer, at one time intended the boy for the church, but in consequence of a severe illness his studies were first interrupted and finally abandoned. He then turned his attention to his father's occupation, and removed to Glasgow with the double object of finding employment among its manufacturers and intellectual improvement among its literary society. Before he had reached his twentieth year he had written, and in 1853 he published, his *Life Drama*. It was at first enthusiastically received as a poem of the highest order, but a reaction of dissent soon set in headed by Professor Aytoun, who in his burlesque tragedy of *Firmilian* characterized Smith's production as belonging to the spagmodic school. In 1854 Smith was appointed secretary of the University of Edinburgh, and the follow-

ing year produced, in conjunction with Sydney Dobell, a volume of *Sonnets on the War*. This was followed in 1857 by his *City Poems*, to which succeeded his longest and best work, *Edwin of Deira* (1861). He now seems to have turned his attention seriously to prose composition. He became an active contributor to *Blackwood's* and *Macmillan's Magazines*, the *North British Review*, *Good Words*, and other periodicals. In 1863 he published a collection of papers entitled *Dreamthorp*, which was succeeded by *A Summer in Skye* (1865) and *Alfred Hagart's Household* (1865). He edited the *Globe* and the *Golden Treasury Series* editions of Burns' works, and wrote several biographies for the *Encyclopædia Britannica* and *Chambers's Encyclopædia*. His death took place at Wardie, near Edinburgh, 5th January, 1867.

**SMITH, HORACE and JAMES**, the joint-authors of the celebrated *Rejected Addresses*, were the sons of Robert Smith, solicitor to the Ordnance, and born, James in 1775, and Horace in 1779. James Smith followed his father's profession, but Horace adopted that of a stock-broker. Being both of a literary turn the brothers became contributors to the *Pic Nic* newspaper, founded by Colonel Greville in 1802, and afterwards wrote several prefaces to a new edition of *Bell's British Theatre*. From 1807 to 1810 they contributed numerous papers to the *Monthly Mirror*, and among these the *Imitations of Horace*, which were afterwards published separately. In 1812 the competition offered by the management for the best address to be read at the opening of Drury Lane Theatre, when rebuilt after the fire, suggested to the Smiths the idea of producing a collection of parodies of the most noted writers of the day, under the designation of the *Rejected Addresses*. The work on being issued was hailed with the most enthusiastic applause, and rapidly ran through numerous editions. Its popularity still continues great, and deservedly, for few *jeux d'esprit* are more happy than the burlesques of the poetry of Wordsworth, Crabbe, and Sir Walter Scott, the pompous prose of Johnson, or the bluntness of Cobbett. The parodies written for the *Addresses* by Horace Smith were Nos. 1, 3, 4, 6, 8, 9, 10, 11, 12, 15, and all after No. 20, the remainder being by his brother James. Stimulated by success Horace set himself now to the writing of novels, and produced among others *Brambletye House*, *Reuben Apley*, *The Moneyed Man*, *Adam Brown*, and *Arthur Arundel*. His brother James having died he published in 1840 a memoir of him, with his literary remains. His own death took place at Tunbridge Wells on 12th July, 1849.

**SMITH, SIR JAMES EDWARD**, an eminent botanist, was born at Norwich in 1759, chose medicine as a profession, and studied at Edinburgh College, where he embraced with enthusiasm the pursuit of botany. He subsequently made the acquaintance of Sir Joseph Banks, and in 1784 induced his father to purchase for him, at the expense of £1088, the magnificent museum and collections in natural history formed by Linneus, and at that time exposed for sale. In 1786 he took the degree of M.D. at Leyden, and in that and the following year accomplished a tour through France, Italy, and Switzerland. An account of his journey was afterwards published by him under the title of *A Sketch of a Tour on the Continent*. The *Linnean Society*, of which he continued president till his death, was founded by him in 1788, in conjunction with the Bishop of Carlisle and others. The post of instructor in botany to Queen Charlotte and the princesses of the royal family was bestowed on him in 1792. In 1797 he commenced practice as a medical man in his native town, and resided there during the remainder of his life, making annual

visits to London to deliver lectures at the Royal Institution. In 1814 the prince regent conferred on him the dignity of knighthood. Sir James Smith's principal works are *English Botany* (thirty-six vols. 8vo), *Natural History of the Lepidopterous Insects of Georgia* (1797, two vols. fol.), *Flora Britannica* (1803-4, three vols. 8vo), and the *English Flora* (four vols. 8vo). He also contributed the bulk of the articles on botany and botanical biographies to *Rees's Cyclopaedia*. He died in 1828.

SMITH, JOHN PYE, D.D., a noted divine and theological writer of the Independent persuasion, was the son of a bookseller at Sheffield, and born there in 1774. In the early part of his life he was extensively engaged in teaching, and afterwards acquired for himself a distinguished reputation by his religious writings, which bear mainly on the vindication of orthodox Christianity. Among them are treatises on the Divinity of Christ; On the Harmony of Geology with Revealed Religion; Scripture Testimony to the Messiah, a well-known book which went through several editions; and *Principles of Interpretation as applied to the Prophecies of Holy Scripture*; besides various sermons and addresses. During a great part of his life he was resident tutor of the Independent College at Homerton, but retired from it in 1850. He died shortly afterwards on the 5th February, 1851.

SMITH, JOSEPH, founder of the Mormons. See **MORMONS**.

SMITH, SYDNEY, a celebrated churchman, noted for his wit and humour both as an author and in the social circle, was born at Woodford, in Essex, in 1771, but his father ultimately settled at Bishop's Lydiard, in Somerset. Sydney was educated at Winchester School, where his talents raised him to the position of 'captain'; and in 1789, being destined for the church, entered New College, Oxford, where he took his degree of M.A. in 1796, and of which a few years afterwards he became fellow. On leaving college he obtained in 1797 the curacy of Nether-avon, a village in Salisbury Plain, near Amesbury, where he passed a secluded and apparently very dreary life for about two years. The principal proprietor of the parish, Mr. Hicks Beach, whose friendship he had gained, then chose him as travelling tutor to his son, about to proceed to the University of Weimar, in Germany. The troubled state of the Continent, however, prevented them going there, and Smith with his ward proceeded instead to Edinburgh, then renowned for its educational advantages, and as being the seat of a brilliant array of talent, both in a social and literary point of view. Here he continued for five years, and made the acquaintance of the most distinguished intellectual men of the day, including more especially that circle of youthful genius, composed of such men as Jeffrey, Horner, Walter Scott, Lord Brougham, Leyden, and others. Many of them espoused with ardour liberal views in politics and literature, and with the view of disseminating these Mr. Smith proposed to his comrades the starting of a Review, a project which was entered upon with enthusiasm. Thus commenced in 1802 the famous *Edinburgh Review*, of which Jeffrey acted as editor for many years, and Smith as one of its raciest and most influential contributors. In 1804 Mr. Smith removed to London, about the same time married, and became renowned as an able and eloquent preacher at the Foundling Hospital and other chapels, and also as one of the most genial and wittiest of social companions. He also delivered a course of lectures on moral philosophy at the Royal Institution, which were extremely popular, and were subsequently published. In 1806, during the reign of the Whig party, he was presented to the living of

Foston-le-Clay, in Yorkshire, in one of the most secluded and primitive parts of the kingdom. Arriving there with his wife and family he set himself assiduously to the duties of his new charge, built for himself a parsonage house, and though struggling often with difficulties, never allowed them to get the better of his genial temper and buoyant spirits. The account given by himself of his settlement at Foston-le-Clay, as quoted in his *Memoirs*, is one of the choicest pieces of humorous writing in our language. In 1807 appeared anonymously his celebrated *Letters of Peter Plymley*, intended to further the cause of Catholic emancipation, the disagreement on which with King George III. caused the downfall of the Fox and Grenville ministry. During his residence in Yorkshire Mr. Smith continued to contribute frequently to the *Edinburgh Review*, and was frequently cheered in his retreat by numerous visits from his literary and political friends. His liberal views on politics, however, excluded him from church preferment; but in 1828 he was presented to the rectory of Combe Florey, in Somersetshire, to which he removed with great satisfaction. In 1831, during the ministry of Earl Grey, he became one of the canons of St. Paul, but this was the utmost dignity to which he attained in the church. Not long afterwards he came prominently forward in a series of pungent epistolary attacks on Lord John Russell, occasioned by his introduction of a bill into Parliament which materially encroached on the rights of deans and chapters. About his last literary effort was the exposure of the fraud perpetrated by the state of Pennsylvania in the repudiation of its public debts. Mr. Smith was himself a sufferer by this breach of national faith, and his sarcastic remarks on the subject excited both a little amusement at home and not a little indignation on the other side of the Atlantic. He died of water on the chest on 22d February, 1845. A few years before his death a collected edition of his writings was published under his own superintendence. A memoir of him, issued after his death by his daughter, Lady Holland, represents him as he really was, a man of solid as well as brilliant qualities, and most exemplary in all his relations. See the *Life and Times of Sydney Smith* by S. J. Reid (1854).

SMITH, WILLIAM, the first great original discoverer in English geology, was born at Churchhill, in Oxfordshire, in 1769. After receiving an irregular education, during the course of which he displayed considerable talents for mathematics, he in 1787 became an assistant to a land-surveyor; and in the course of his employment traversed the collieries of Oxfordshire and Gloucestershire, and the lias and red marls of Worcestershire. He afterwards began to act as a mining surveyor, and was led from some of his surveys of collieries to the idea of framing a model of the strata of a coal country, composed of the materials of the strata reduced to a scale, and placed in their relative positions to each other. He next began to practise as a canal engineer, and while thus employed he gained much practical knowledge of geology, gathered some vague notions concerning the distribution of organic remains, and proceeding step by step, ultimately became convinced that each stratum contained its own peculiar fossils, and might be discriminated by them. He now began seriously to contemplate the composition of a regular and extensive work on the subject of geology, and in 1801 he issued proposals for his work under the title of *Accurate Delineations and Descriptions of the Natural Order of the Various Strata that are found in the Different Parts of England and Wales, with Practical Observations thereon*. Owing to a combination of causes this work did not appear, but in

1815 Smith was able to submit a complete coloured map of the strata of England and Wales to the Society of Arts, and receive the premium of £50 which had for several years been offered for such a map. His fame as an original discoverer was now secure; but almost about the same time he became involved in pecuniary difficulties, which continued to harass him for several years, obliging him to part with his geological collection to government for £700, and even to submit to the sale of his furniture. He was also unfitted for exerting himself, at the time when exertion had become more than ever necessary, by a paralysis of the lower extremities, caused by over-exertion while exploring the structure of Scarborough cliffs. Ultimately, however, his disease was overcome, a pension was granted him by government, his adversity ceased, honours flowed in upon him, and his old age promised to be long and vigorous. He took a very lively interest in the proceedings of the British Association, and seldom went far from his residence, which he had fixed at Scarborough, except to attend its meetings. He was on his way to attend that appointed to be held at Birmingham in 1839, when he was suddenly taken ill at Northampton, and died there a few days after, in the seventieth year of his age.

SMITH, SIR WILLIAM, D.C.L., classical scholar and editor, was born in London in the year 1813, and educated at the University of London, where he obtained first prizes in Latin and Greek. On leaving the university he entered Gray's Inn and studied law, but he never practised. His love of classical literature determined his career, and the first important work on which he was engaged was his *Dictionary of Greek and Roman Antiquities*, completed in 1842, a second edition of which appeared in 1848, and a third edition in 1891. This was followed by the *Dictionary of Greek and Roman Biography and Mythology* (1843-49), and this series of valuable classical hand-books was completed by the *Dictionary of Greek and Roman Geography* (1858-57). A useful *Latin-English Dictionary* was also produced by him, being published in 1855. These undertakings were followed by a series of school dictionaries of classical subjects, and by his well-known school manuals *Principia Latina* and *Initia Græca*, which embodied a new method of teaching these languages. Among his other editorial labours may be mentioned those in connection with his series of historical text-books, of which the history of Greece was from his own pen; a complete edition of Gibbon's *Decline and Fall*, in 8 vols.; and a valuable *English-Latin Dictionary* (1870). What he himself considered of most importance, however, was his series of theological dictionaries, which included the *Dictionary of the Bible*, in 3 vols. (1860-63); *A Dictionary of Christian Antiquities*, in 2 vols. (1875-80); and a *Dictionary of Christian Biography, Literature, Sects, and Doctrines during the First Eight Centuries*, in 4 vols. (1877-87). In the year 1867 he became editor of the *Quarterly Review*, and this post he occupied until his death in October, 1893. Among the well-merited honours conferred upon him were the Oxford degree of D.C.L.; and the Glasgow degree of LL.D.; while in 1892 he accepted the honour of knighthood.

SMITH, WILLIAM ROBERTSON, oriental scholar and editor, was the son of the Free Church minister of Keig, Aberdeenshire, and was born there in 1846. He was educated at Aberdeen University, where he graduated in 1865, taking the highest honours in more than one subject. Subsequently he spent some time at the New College, Edinburgh, and continued his German studies at Bonn and Göttingen, where his ideas upon scientific research

were acquired. Thereafter, from 1868 to 1870 he acted as assistant to Professor Tait, professor of physics in Edinburgh University. In 1870 he was appointed to the chair of Hebrew and New Testament exegesis in the Free Church College at Aberdeen. His free criticism of the Old Testament writings resulted in a charge of heresy, and after prolonged discussion in the Free Church courts, during which his honesty was not more conspicuous than his learning, he was removed from his professorship in 1881. From this period he became associated with Professor Baynes in the editorship of the *Encyclopædia Britannica*, and when the latter died he succeeded to the position of editor-in-chief. Meanwhile he had visited Arabia in 1879-80, where he gained an intimate knowledge of the people and their language, which qualified him to fill the position of lord almoner's professor of Arabic in Cambridge University, to which he was appointed in 1883. Subsequently he became a fellow of Christ's College, and on the death of Henry Bradshaw in 1886 he was elected university librarian, a post which he exchanged in 1889 for the Adams professorship of Arabic. For a number of years he struggled bravely against the decay of his physical powers, but he was never quite able to accomplish any literary work equal to his great intellectual attainments. His death occurred on the 31st March, 1894. Probably his most popular works are *The Old Testament in the Jewish Church* (1881), and *the Prophets of Israel* (1882). But he is best known to scholars as the author of *Kinship and Marriage in Early Arabia* (1885); and his first series of Burnett lectures, *Religion of the Semites: Fundamental Institutions* (1889).

SMITH, ADMIRAL SIR WILLIAM SIDNEY, an eminent naval commander, was born in Westminster in 1764, his father being a captain in the guards, and at thirteen years of age he entered the royal navy. He saw some service in the American war. When only sixteen he received his lieutenantcy, and when nineteen was created post-captain. On the outbreak of war between Sweden and Russia he entered the service of the former power as a volunteer, without official consent, and performed such distinguished services that he was invested by Gustavus III. with the order of the Sword. Happening to be in the south of Europe on the surrender of Toulon to Lord Hood in August, 1793, he hastened thither and offered him his services, and in the following month of December on the evacuation of the city, was intrusted with the destruction of the French ships of war and stores that could not be removed. On returning to England he received the command of the *Diamond*, for the purpose of cruising with a small flotilla against the French in the Channel. Here he was made prisoner in an attempt to cut out a vessel at Havre, and was detained in confinement for two years, but contrived to make his escape to his native country. He was now appointed to the command of the *Tigre*, and despatched to the Levant, where Bonaparte was then besieging Acre, on the coast of Syria, with a force of 10,000 men. Sir Sidney brought in two of his largest ships close to the shore, landed a party of sailors and marines, repulsed the French on several occasions with heavy loss to them, and ultimately compelled Bonaparte to raise the siege of the town. He subsequently took an active part in the operations on the Egyptian coast, and received a severe wound in the battle of Alexandria. On his return to England various marks of distinction were bestowed on him, and in 1802 he entered Parliament as member for Rochester. Upon the recommencement of hostilities after the short peace he received an appointment to the command of the *Ant-*

*lope*, was created in 1805 rear-admiral of the blue, and in 1806, as commander of a small squadron, inflicted signal injuries on the French off the coast of Naples. Next year he accompanied Admiral Duckworth to the Dardanelles, where he distinguished himself by the destruction of a Turkish squadron. In 1810 he was made vice-admiral; he was appointed in 1812 second in command of the Mediterranean fleet, and till the end of the war stationed off Toulon. A pension of £1000 a year and the decoration of K.C.B. were then bestowed upon him. He attained the rank of admiral in 1821, and in 1830 succeeded King William IV. as lieutenant-general of marines. During the last years of his life he resided at Paris, and there died on 26th May, 1840. See the *Life* by Barrow (two vols., 1848).

SMITHFIELD, a square in London, a little north of Newgate and west of Aldersgate, in which, until 1855, the only market in London for live stock was held. It was outside the old city walls, and in the eleventh century was an open spot where the citizens delighted to promenade. Before the days of Tyburn, Smithfield (now called West Smithfield to distinguish it from East Smithfield, Tower Hill) was the place of public execution. Here Sir William Wallace, and Mortimer, Earl of March, suffered death; here Walworth, the mayor, stabbed Wat Tyler the rebel; and here Jack Straw was hanged. Tournaments were held on this spot; Edward III. celebrated the deeds of Cressy and Poitiers by mimic feats of arms here; and here Richard II. gave a three days' tournament to celebrate his marriage. A more terrible page of history tells of the murders by way of burning which took place here in the name of religion. Bartholomew Fair, so often mentioned in our literature, was held at Smithfield. (See BARTHOLOMEW FAIR.) We find mention of a cattle market having been held here as far back as 1150. The corporation had official control over the market for above 500 years, dating from 1345. The nuisance occasioned to the streets of London by the droves of cattle and sheep that were brought here for sale at last became intolerable, and the trade was transferred to the large and complete Metropolitan Cattle Market, near the Caledonian Road. On the site of the old market there has been erected a magnificent dead-meat market, 625 feet in length by 240 in breadth, traversed by numerous avenues and having 200 shops for meat-dealers. Meat and poultry are brought direct from the country and from the Metropolitan Cattle Market by means of rails laid under the market, by which it is connected with the Metropolitan and other railways.

SMITHSONIAN INSTITUTION, a scientific institute in Washington, in the United States, organized by act of Congress in April, 1846, to carry into effect the provisions of the will of James Smithson, the founder. Smithson was the natural son of Hugh, first Duke of Northumberland of the third creation, and Elizabeth Keate, a cousin of the duke's wife; was educated at Oxford, where he distinguished himself as a chemist, and in 1787 was elected a Fellow of the Royal Society. He was the friend and associate of Wollaston, Davy, Banks, and other great scientific men of the age. He never married, nor had he any fixed place of abode, spending the most part of his time in travel. He died at Genoa in 1829. He bequeathed his property (worth £120,000) to his nephew, with the condition that if the latter died without issue the property was to go to the United States to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men. In 1835 the nephew died childless, and in 1838 the sum of 515,169 dollars was paid over

to the treasury of the United States. On this sum the treasury agreed to pay interest at the rate of 6 per cent per annum. In 1846 the interest amounted to 242,129 dollars, which sum was applied to the erection of a suitable building, with apartments for the reception and arrangement upon a liberal scale of objects of natural history, &c.; also a chemical laboratory, a library, a gallery of art, and lecture-rooms. The fund has been very considerably augmented since, but only the interest accruing from it is expended. A portion of the funds of the institution is devoted to scientific researches, and the publication of works too expensive for private enterprise. It receives copies of copyright books, and spends part of its funds in spreading knowledge, by the interchange of scientific and other publications between the United States and other countries. Its publications include three sets, namely the Smithsonian Contributions to Knowledge, the Miscellaneous Collections, and the Annual Report. The first comprise original investigations and positive additions to knowledge in all branches of science, such investigations being usually aided by the institution. The Annual Reports contain a statement of the operations of the institution, and much valuable information collected from various sources. The Miscellaneous Collections, an occasional series, comprise memoirs intended more especially to further the study of natural history. Correspondence is kept up with eminent scientific men in all quarters of the globe, and public lectures are delivered in the rooms of the institution. A national zoological park, an astrophysical observatory, and a bureau of ethnology have been founded in connection with it. The Smithsonian building is one of the finest in the United States. The Smithsonian library is now incorporated with that of Congress, and the gallery of art has also been removed, the institution devoting itself entirely to the increase and diffusion of knowledge. The institution is governed by regents, composed of the chief-justice, three members of the Senate, three of the House of Representatives, with six other persons.

SMOKE NUISANCE. By 38 and 39 Vict. cap. lv. and other acts, all fireplaces and furnaces and chimneys (exclusive of the chimneys of a private dwelling) must be so constructed or altered so as to consume or burn their smoke, under a penalty not exceeding £5 nor less than £2, on a second conviction £10. Steam-vessels plying on the Thames are required to consume or burn their smoke under like penalties. It is not imperative by the terms of the act that *all* the smoke shall be burned or consumed, and justices will dismiss the charge against persons who can prove that, having regard to the manufacture, the fireplaces are so constructed as to consume the smoke as far as possible, and that due care has been taken to prevent the emission of smoke. Constables may be empowered to enter factories or other public works and inspect furnaces and steam-engines. There are many practical difficulties in the way of consuming smoke, but experience has shown that none of them are of such a nature that they may not be overcome by skill, care, and perseverance. They all merge into one common principle, that of mixing air with the combustible vapours and gases generated by the action of heat on the fuel, so that by virtue of a due supply of oxygen they may be made to burn with flame, and become entirely converted into incombustible and invisible vapours and gases, instead of being, as they now are, only partially burned, their carbon being precipitated, and escaping, together with the other imperfectly-consumed matters, into the air. See WARMING AND VENTILATION.

SMOLENSK, a government in Russia, bounded north by Tver, east by Moscow and Kaluga, south

by Orel and Czernigov, and west by Mohilev, Vit-ebsk, and Pakov; greatest length, north to south, 285 miles; central breadth, 180 miles; area, 21,688 square miles; pop. 1,551,058. It consists generally of extensive plains, occasionally marshy; and belongs partly to the basin of the Baltic, which receives its drainage by the Dwina and its affluents, but much more to the Black Sea, which drains it chiefly by the Dnieper. A small portion is carried to the Caspian by the Volga. The climate, though cold, is clear and healthy, and the soil tolerably fertile, producing good crops of rye, the principal object of culture; hemp and flax are also extensively cultivated, and in particular districts hops and tobacco. The pastures are excellent, and the forests, covering a large extent of surface, yield excellent timber. The rearing of bees forms an important object of rural economy, and much wax and honey are exported. Swine are also reared to a considerable extent. The chief minerals are copper, iron, and salt. Manufactures and export trade are both largely increasing.

**SMOLENSK**, a town of Russia, capital of the above government, on both sides of the Dnieper, 250 miles w.s.w. of Moscow. The part on the left bank of the river is surrounded by a strong and lofty wall, flanked by towers. The part on the right bank is also fortified, but the wall is only of earth. The interior of the town contains a large extent of open ground, partly occupied as gardens, and presents in general a very poor appearance, most of the houses being of wood and one story high. The only exception is in the centre of the town, where there is a large and handsome square. The principal buildings are three cathedrals, about twenty-five churches, an episcopal palace, a diocesan seminary, gymnasium, &c. The manufactures consist of linen, leather, hats, carpets, and soap; and the trade is chiefly in corn and hemp. Smolensk is an old town, having been a place of great importance in the ninth century. In 1812, after the great battle which bears its name, it was taken by the French, on their way to Moscow, and a great part of it burned down; a disaster from which it has only partially recovered. Pop. (1897), 46,899.

**SMOLLETT**, **TOBIAS GEORGE**, a celebrated novelist and miscellaneous writer, was born near Renton in Dumbartonshire in 1721. He was first taught at the parish school of Dumbarton, and he afterwards prosecuted his studies at the College of Glasgow. Here he contracted a fondness for the medical profession, and was apprenticed to a surgeon named Gordon. In the seventeenth year of his age he wrote a tragedy, called the *Regicide*, the subject of which was the assassination of James I. of Scotland. In 1740, when his apprenticeship was finished, he set out for London to solicit employment in the army or navy, and to bring his tragedy upon the stage. Although the exertions of his friends could not recommend his play to the favour of the theatres, they procured for him the situation of surgeon's mate to one of the ships of the line that went out in the unfortunate expedition to Carthage in 1741 under Admiral Vernon. Of this blundering affair he gave an account in his *Compendium of Voyages and Travels* (seven vols. 12mo, 1757), as also what may be called a personal narrative in *Roderick Random*. Disgusted with the navy, our author quitted the service in the West Indies, and resided for some time in Jamaica, where he became acquainted with a Miss Lascelles, whom he married in 1747. In 1746 he returned to London, where he heard for the first time of the barbarities exercised by the Duke of Cumberland in the north of Scotland. This drew from him an indignant burst of patriotic eloquence, the well-known ode entitled *The*

*Tears of Scotland*. In the same year he published his *Advice*: a Satire, an acrimonious attack upon several individuals of rank and fortune; and wrote an opera, entitled *Alceste*, for Covent Garden Theatre, but it was neither acted nor printed. In 1747 he published his *Reproof*: a Satire, being the second part of the *Advice*, continuing the same system of inveterate attack upon all the leading personages of the times. In 1748 appeared his *Adventures of Roderick Random*, in two volumes, a work which brought him both fame and fortune. The tragedy of the *Regicide*, already mentioned, was published in 1749, and was also profitable. He went to Paris in 1750, and about this time he composed his *Adventures of Peregrine Pickle*, with the *Memoirs of a Lady of Quality*, which appeared in 1751 in four volumes. This work is marked with broad humour and great knowledge of the world. Real personages and real incidents are often described, as in *Roderick Random*; but the adventures, and frequently the language, were stained with an indelicacy and immorality highly reprehensible. The *Memoirs* inserted in the book were written by Lady Vane, who paid a large sum to the novelist for publishing this record of her shame. Notwithstanding the great success of *Roderick Random* and *Peregrine Pickle*, Smollett seems to have been anxious to quit the profession of an author. He obtained about this time the degree of M.D., and announced his intention to practise medicine by a work entitled *An Essay on the External Use of Water* (1752). In the practice of physic, however, he was not successful, and was compelled again to have recourse to his pen. In 1753 he published his *Adventures of Ferdinand, Count Fathom*, in two volumes, but it was neither so ably written nor so popular as its predecessors. In 1755 he brought out a new translation of *Don Quixote*, in two volumes. Soon after he was induced to take the chief management of the *Critical Review*, which began in 1756 under the patronage of the Tories, and in opposition to the *Monthly Review*, which had commenced in 1749. His next work was the *Compendium of Voyages and Travels*, already mentioned. In 1757 he produced the *Reprisal, or the Tars of Old England*, a comedy in two acts, which proved a success. Early in 1758 Smollett gave to the world his *Complete History of England*, deduced from the Descent of Julius Cæsar to the Treaty of Aix-la-Chapelle in 1748, in four volumes. This work is said to have been composed and printed in fourteen months. For an article in the *Critical Review* that was decided to be libellous he was sentenced to pay a fine of £100 and suffer three months' imprisonment. During his confinement he composed his *Adventures of Sir Lancelot Greaves*, which was published in two vols. in 1762. About this time he may have written part of the *Histories of France, Italy, and Germany for the modern part of the Universal History*; but it is doubtful if any important part of these *Histories* was really written by him. In 1761, 1762, and 1765 he published, in five volumes, his *Continuation of the History of England down to 1765*. The unpopular administration of Lord Bute was naturally defended by Smollett when he perceived that its unpopularity was in some measure owing to the premier being a Scotsman. For this purpose he established a weekly paper called the *Briton*, which was killed in less than a twelvemonth by the North *Briton*, under the management of John Wilkes. In 1766, after a residence of about two years on the Continent, he published his *Travels through France and Italy*; and in 1767 his *History and Adventures of an Atom*, a political romance displaying under Japanese names the different party men in Great Britain from 1756 to 1761. He again visited Italy in

1770. After a short residence at Leghorn he retired to Monte Nuovo, a romantic situation in its vicinity. Here he composed his *Expedition of Humphry Olinker*, which is regarded as one of the best of all his works. This was the last effort of his pen. His strength gradually declined, and he died at his house near Leghorn on the 17th September, 1771. The humour of Smollett is of the broad, full-flavoured kind, not seldom degenerating into burlesque; his characters are well marked and varied, though their distinguishing features are rather superficial than belonging to the deeper aspects of human nature; his style is easy, and altogether his novels are interesting and decidedly amusing, though they cannot be freed from the charge of occasional coarseness and vulgarity. Among editions of his works may be mentioned that of J. Moore (eight vols., 1797; re-issued in eight vols. by J. P. Browne, 1872), and that of G. Saintsbury (twelve vols., 1895). Besides the biographies in the above editions, those by Robert Chambers (1867), David Herbert (1870, in *Selected Works*), D. Hannay (1887), and O. Smeaton (1897) may be recommended.

SMOLT, the name given to the young of the Salmon, usually at the end of its second year of life, and after it has passed through the 'parr' stage. The smolt dress is a distinctive covering of white silvery scales. When the parr becomes a smolt it goes to the sea, and there attains in some cases a very great degree of growth, returning from the sea to its native river as the 'grilse'. See SALMON.

SMUGGLING, the offence of importing prohibited goods, or of defrauding the revenue by the introduction of goods into consumption, without paying the duties chargeable upon them. It may be committed either upon the excise or the customs revenue, but frauds on the excise are generally less common than on the customs. In Great Britain persons who keep, harbour, or conceal smuggled goods, or suffer or permit it so to be done, forfeit treble the value, or pay the penalty of £100. Any officer duly employed for the prevention of smuggling may, on producing his warrant, go on board any ship within the limits of any port of the United Kingdom, and search all parts of such ship for smuggled goods; he may also stop and examine any cart, wagon, or other means of conveyance, for the purpose of ascertaining if it contains any smuggled goods; and he may search any person on board a vessel within the limits of any British port, or after they have landed. If he is obstructed in the execution of his duty the penalty is £100. Armed combinations for smuggling purposes are felonies, and are severely punished. This crime is mostly the result of vicious commercial and financial legislation. It is the fruit of either prohibitions of importation, or of oppressively high duties on goods. A prohibition against importing a commodity does not take away the taste for it, and the imposition of a high duty on any article occasions a universal desire to escape or evade its payment. Hence the rise and occupation of the smuggler. The risk of being detected in the clandestine introduction of goods under any system of fiscal regulations can always be valued at a certain rate, and whenever the duties exceed this rate, smuggling is almost sure to take place. The prohibition of foreign silks in Britain previously to 1826 did not hinder their importation in large quantities. The vigilance and integrity of the custom-house officers were no match for the ingenuity, daring, and bribes of the smugglers. The enormous duties imposed until 1823 on home-made Scotch and Irish spirits produced an extent of smuggling and demoralization of which it is now difficult to form an idea. The true way to put down smuggling is to make it unprofitable, and this can

be done only by repealing prohibitions and reducing duties to such an extent that the profits of the honest dealer become nearly equal to those of the smuggler. In Britain, smuggling is now carried on to a very small extent, though no doubt some foreign tobacco and spirits are clandestinely imported, and some illicit distilling is carried on. The latter is said to be not uncommon in parts of Ireland, and the Scottish Highlands are not free from it.

SMUT, or DUST-BRAND, a disease of plants, especially of the cereal grasses, due to the presence of fungi of the families Ustilaginaceæ and Tilletiaceæ. These two families are best regarded as intermediate between the lower fungi (such as those of the potato-disease and the salmon-disease) and the higher Ascomycetes and Basidiomycetes. The mycelium of fungi of these families grows in the living tissues of the host and concludes its development with the production of chains of thick-walled, dark-coloured chlamydospores, to whose appearance in the mass the name of the disease is due. These chlamydospores germinate only after they have been distributed. A short tube, called the promycelium, develops from them, and from this tube conidia (or sporidia) are abstracted. These conidia will bud in a suitable soil, producing new conidia, and these in turn can bud. Thus, the soil may become thoroughly infected, and any young plant of a suitable species is liable to be attacked by them. The common smut of wheat, oats, barley, and other grains is *Ustilago segetum* (or *carbo*), whose conidia penetrate the tissues of young growing plants. If the plants reach a certain stage unattacked by these conidia, they are safe from infection, for the parasite cannot penetrate the hard, adult tissues. The presence of the fungus does not become externally apparent until the grain begins to ripen, but soon after this the dark chlamydospores are formed. *Tilletia tritici* and allied fungi are known as stinking-smut or bunt. See BUNT.

SMYRNA (Turkish, *İzmir*), an ancient city and important seaport of Asiatic Turkey, on the west coast of the pashalic of Anatolia, at the head of the gulf of the same name (a sheltered inlet of the Archipelago extending inwards for about 45 miles), having in front a broad quay and artificial harbour, the former traversed by a tramway. The appearance of the city from the sea is extremely attractive, and is much heightened by the picturesque scenery around it, but a closer inspection dissipates the illusion. The houses, except in the Frank or European quarter, were at one time nearly all constructed of wood, but they are now mostly of stone. The city is divided into four quarters—Frank, Turk, Greek, and Armenian. The bazaars are dark and dirty, but have a somewhat striking appearance from the variety and brilliancy of the colours of the silk, woollen, and cotton goods exposed for sale. The public buildings include the palace of the governor, a large barrack, a number of mosques, and several Greek, Armenian, Roman Catholic, and Protestant places of worship, the British consular chapel, two English and an American church. There is a British seamen's hospital here, for which a new building was erected in 1897. New water-works were completed in 1898. Smyrna has been for centuries the most important place of trade in the Levant. This trade has been carried on partly by shipping, partly by caravans from the interior, and latterly it has been aided by two railways having a length respectively of 304 and 165 miles. The commerce is increasing rapidly. The chief imports are cotton and woollen manufactured goods; colonial goods, mostly coffee and sugar; iron, coal, hardware goods, leather, timber, glass-ware, butter and margarine, drugs, jute bags, petroleum, &c.

The principal exports are raisins, figs, valonia, cereals, tobacco, gum-arabic, opium, carpets, cotton, wool, liquorice, olive-oil. In 1900 the exports amounted to £2,541,172 (in 1899, £3,782,781), and the imports to £1,425,480 (in 1899 £2,562,855). Britain has a considerable share in the trade. Smyrna has been frequently injured by earthquakes and has also suffered severely from fire. The climate is variable, and fever (usually of a mild type) is prevalent. There are conflicting accounts of the origin of this city; the most probable is that which represents it as an Æolian colony from Cyme. About 688 B.C. it fell into the hands of the Ionians of Colophon. This earliest city, called by the Greeks Old Smyrna, was situated on the banks of the Meles, on the north-east side of the Hermean Gulf (now the Gulf of Smyrna). It laid claim to the honour of being the birthplace of Homer, and its coins bore his image. This old city was abandoned, and was succeeded by a new town on the south-east side of the gulf (the present site), which was said to have been built by Antigonus, and enlarged and embellished by Lysimachus, both generals of Alexander the Great. It was laid out with great magnificence, and adorned with several splendid buildings, among which was the Homereum, where the poet was honoured as a god. It soon became one of the greatest and most prosperous cities in the world. It was especially favoured by the Romans on account of the aid it lent them in the Syrian and Mithridatic wars. In the civil wars it was taken and partly destroyed by Dolabella, but it soon recovered. It is one of the two amongst the seven churches in Asia which St. John addresses without rebuke, and it was the scene of the labours and martyrdom of Polycarp. In the thirteenth century only the ruins of its former splendour were left; but after the Turks became masters of the country it began to revive, and it is now the most flourishing city of Asia Minor. Pop. about 200,000, fully half being Greeks, and the rest Turks, Jews, &c.

**SNAIL**, the name given to various genera of Gasteropodous Mollusca, included in the Pulmoniferous or 'lung-bearing' section of that class. Popularly snails are distinguished from 'slugs' by possessing a shell. The Snails further form typical examples of the section Inoperculata, or that group in which the shell is destitute of an operculum or plate for closing its entrance when the animal has withdrawn into its abode. The various genera of snails are distributed throughout several families. The most typical members of the snail genera belong to the family Helicidae, which includes the Land Snails proper. This family is distinguished by its members possessing a well-developed shell, which is capable of containing the whole animal when retracted within its abode. Four retractile tentacles exist, the upper pair being the larger and possessing eyes at their tips. A distinctly-developed so-called 'foot' is present. The aperture by means of which air is admitted to the lung-chamber for the purpose of breathing exists on the right side, under the edge of the shell. The mouth possesses an upper mandible of horny consistence and toothed structure, and, as in other Gasteropoda, there is a tongue or lingual ribbon bearing many teeth. (See MOLLUSCA.) The food is generally of a vegetable nature, and snails are capable of doing great mischief in gardens. In the snails the sexes are united in the same individual; but the copulation of two such hermaphrodite individuals is necessary for impregnation. The genus *Helix* includes the most typical species of snails, and is distinguished by the oblique, transverse, or crescentic aperture of the shell, and by the elongated foot being of pointed shape posteriorly. The snails mostly

hibernate in winter, and close the mouths of their shells with a layer of hardened mucus, known as the *epiphragm*. In the family Helicidae, and in addition to the genus *Helix* itself, there are included several other genera—*Clausilia*, *Achatina*, *Pupa*, *Bulimus*, *Vittrina* and *Succinea*—with noteworthy species. The Common Garden Snail (*Helix aspersa*) is the most familiar species of the typical genus; and equally well known is the *H. pomatia* or Edible Snail, not very common in England, but largely found in France, and cultivated there and elsewhere for food purposes. Among the Romans snails were held in high esteem as articles of food and even of luxury; and special parks or establishments named '*Cochlearia*' (from *cochlea*, a snail) were constructed for the purpose of fattening these molluscs. The practice of eating snails has never been very common in England, but Howard, the prison philanthropist, tried to encourage it, and it is indulged in in some localities. Howard cultivated the *H. Varronis*, the largest of European species. In modern Europe, as in many parts of France, and in Vienna, especially during Lent, snails are largely consumed, especially among the lower orders. The *lazzaroni* or beggars of Naples are exceedingly fond of a soup made from *H. nemoralis*. The most valued species among modern epicures is the *H. vermiculata* or Little Hermit Snail, found at Montpellier; and *H. aspersa* is also regarded as very delicate when properly cooked. *H. pomatia* has a wider range as an edible snail, especially in Northern France. Its shell is globose, and marked with broad bands of a rusty colour. Snails are a favourite food of thrushes and blackbirds, which break the shell against a stone.

The Pond Snails are included in quite a distinct family—that of the Limnæidæ. In this family the shell is large and thin, the lip sharp, the muzzle short and broad, and the eyes are placed at the base of the tentacles. The genera *Limnaea*, *Physa*, *Ancylus*, and *Planorbis* are included in this family. Of the first-named genus, with its spiral shell—its last whorl wide—and the triangular tentacles, *Limnaea stagnalis* or the Common Water Snail is the best-known species. This form is found in streams and pools, and crawls upon the leaves and stems of aquatic plants. The equally common *Planorbis corneus* possesses a flattened discoidal shell, the whorls of which are coiled round a central axis and lie in one plane. The shell aperture is crescentic in shape, and the foot is round and short. The genus *Physa*, represented by *P. castanea* and the *P. hypnorum* or 'Pouch Shell', has the spiral whorls of the shell turned to the left hand; the tentacles are long and slender, and the edge of the mantle is fringed. The so-called 'Apple Snails', generally included in the Limnæidæ, inhabit lakes and rivers in various tropical parts of the world. But two tentacles exist; and both gills and a lung-chamber are developed—hence these creatures are regarded as being transitional in nature between the Pulmoniferous or 'lung-bearing' and the Branchiate or 'gilled' Gasteropoda.

**SNAKE**. See SERPENT.

**SNAKE-BIRD**. See DARTER.

**SNAKE RIVER**. See LEWIS RIVER.

**SNAKE-ROOT** (*Aristolochia serpentaria*), a plant widely diffused through the United States; but as it grows solitarily in woods, and has nothing conspicuous in its flowers or foliage, and besides does not put forth its shoots till late in the season, it is detected with difficulty. The root is used in medicine, and is exported to Europe. The odour is aromatic; the taste warm, bitter, and pungent; medicinally it is stimulating, diaphoretic, and tonic. (See ARISTOLOCHIA in SUPP.) Many other plants are known by the same name.

**SLAKE-STONES**, small circular pieces of stone or other hard material used for the cure of snake-bites. Some of the snake-stones used in India seem to be efficacious. Two small snake-stones (about the size of a pea) brought from that country, and said to have cured a cobra bite, were found on examination to be composed of some vegetable substance. Another, which was brought from Ceylon by Sir J. E. Tennent, and which was known to have effected a like cure, was submitted to the examination of Professor Faraday, who fancied it to be a piece of charred bone which had been filled with blood perhaps several times, and then carefully charred anew. Owing to their absorbent properties such stones, if applied at once, may be of some avail.

**SLAKE-WOOD**, the heart-wood of the *Brosimum Aubletii* (or *Gutanensis*), a tree of northern South America. The colour of the wood is red-hazel, with numerous black spots and marks which bear some resemblance to hieroglyphics, whence it is sometimes called *letter-wood*. The tree grows to a height of from 60 to 70 feet, and is about 2 or 3 feet in diameter. The outer wood is white and hard; the heart-wood, which seldom exceeds 7 inches in thickness, when finely marked is very valuable. It is used in England for walking-canes, for fine veneer and inlaying work, and for small articles of cabinet-work. The name snake-wood is also given to the *Strychnos colubrina*, a native of India. It is a climbing plant, with small, greenish-yellow flowers; fruit as large as an orange, and of a yellowish colour. This fruit is said by Indian doctors to be a remedy for the bite of the cobra.

**SLAP-DRAGON**. See **ANTIERRHINUM**.

**SNEEK**, a town of Holland, in the province of Friesland, on a lake of the same name, 13 miles s.s.w. of Leeuwarden. It is built on a low, marshy site, and is intersected by several canals. There are manufactures of linen, pottery, leather, &c., and also a trade in butter and cheese. Pop. (1893), 11,501.

**SNEEZE-WOOD** (*Pteroxylon utile*), a large S. African tree of the order Sapindaceæ, yielding timber of a beautiful yellow colour, used for various purposes but troublesome to work from the sneezing caused by its dust.

**SNEEZING** is a violent convulsive motion of the muscles of respiration, preceded by a deep inspiration that fills the lungs, then forces the air violently through the nose. It is usually excited by some irritation affecting the lining membrane of the nose, which may be produced by various causes. Any extraneous body brought into contact with the pituitary membrane will excite sneezing. But sneezing may be excited by stimulation of other nerves besides those distributed to the nostril. Thus, in certain inflammatory affections of the eyeball the eyelids are kept tightly closed, and if, in order to examine the inflamed eye, the eyelids be forcibly opened, a violent sneeze immediately follows. This is due to the light acting as an irritant on the sensory filaments of the inflamed eye, and arousing a reflex action. So, sneezing may be a reflex action determined by irritation in some organ remote from the nostrils. Thus, irritation of the lungs, stomach, and bowels, uterine organs, &c., have been mentioned as causes of sneezing. If it originates only from too great irritability of the membrane of the nose, injections of tepid milk or water into the nostrils may cure it; otherwise, opiates, camphor, and other anti-spasmodics may be necessary. Few animals—perhaps only the dog—sneeze precisely like man. The custom of blessing persons when they sneeze is very ancient and very widely spread. Aristotle professes ignorance of the origin of it. This custom is mentioned by various

ancient writers. Sneezing at sacrifices was considered a good omen.

**SNIATYN**, a town of Galicia, in Austrian Poland, 122 miles south-east of Lemberg, in a beautiful plain on the left bank of the Pruth. It was formerly a frontier stronghold; has a castle, a Greek United and an Armenian church; extensive tanneries, and a considerable trade in horses and cattle. Pop. (1890), 10,939.

**SNIPE**, the name of a genus of Wading or Grallatorial Birds, belonging to the section Longirostres of the order, and included with the Woodcocks in the family Scolopacidae. The sub-family Scolopacinae is specially constructed to include the genera *Scolopax* and *Gallinago*, the first of which contains the various species of Woodcocks. This sub-family is recognized by the straight but flattened bills of its included members, by the bending downwards of the tip of the upper mandible, which overhangs the lower mandible, and by the elevated, short, hinder toe, which, however, touches the ground in walking. To the genus *Gallinago* belong the various species of snipes. This genus is distinguished by the oval form of the nostrils, by the wings having their first and second quills longest, by the thigh being destitute of feathers above the knee, and by the claw of the hind toe being very long and curved. The Common Snipe (*Gallinago gallinula*) occurs very generally throughout Britain, inhabiting marshy districts and fens. This bird exhibits a general colour of brown, which is of dark hue on the top of the head, with a lighter streak marking the centre. The cheeks are of light-brown colour, a dark band, surmounted by a lighter streak, passing from the base of the bill to the eye. The back is coloured with various shades of brown, and four lines of buff mark the upper surface. The wings are black, several of the wing-feathers having white tips. The breast is brownish, with darker markings, the belly white, and the flanks are grayish, marked with black. The average length of the Common Snipe is about 10 inches. The nest is slightly constructed and placed on the ground, usually under the shelter of a tuft of grass or small furze bush. The eggs, numbering four, are coloured olive-white, spotted with brown. The food consists of worms, snails, insects, woodlice, and other Invertebrata. When pursued the snipe has the habit of running in a zigzag fashion, and of thus rendering it very difficult to take a steady aim. When in flight these birds make a peculiar 'drumming' noise with their wings. (See **ORNITHOLOGY**, Pl. V., fig. 13.) The Great Snipe (*G. major*) is by no means so common in England as the preceding species. The average length of the Great Snipe is about 12 inches. Its plumage is marked with brown, as in the Common Snipe; but it possesses cheeks of a paler hue, whilst the markings on the breast and flanks are deeper in colour than in the latter. The line extending from the base of the bill to the eye is also very dark in colour. This bird feeds chiefly on insect larvæ of various kinds, and inhabits swampy places and heaths. The tail is fan-like in shape in flight; and by this peculiarity it may also be distinguished from the common species. The Jack Snipe (*G. media*) is found in Britain chiefly in winter. It does not possess any pale-brown streak on the top of the head. When pursued it generally keeps on the ground; and it has been known to be taken by hand before the pointer's nose. The Brown or Red Breasted Snipe (*G. grisca*) is an American species, possessing a breast of reddish hue, and a white streak extending from the base of the beak to the eye. It rarely occurs in England. Sabine's Snipe (*G. Sabini*) and Brehm's Snipe (*G. Brehmii*) are also rare British visitors. The former

has no white markings on its plumage. (See also WOODCOCK.) The name of Sea Snipe is sometimes given to the Dunlin (*Tringa cinclus*), whilst the name Summer Snipe is applied to the Common Sandpiper (which see).

**SNOW.** Snow-flakes are assemblages of minute crystals of ice; they are probably formed when the temperature in a region containing a considerable quantity of aqueous vapour is lowered quickly below the freezing-point. If the change of temperature occurs slowly, fine hail may be formed. In the Arctic regions the atmosphere is often full of minute crystals of ice which give rise to haloes and parhelia. When a piece of glass or a piece of dry ice is pounded it becomes white, on account of the light reflected from the many surfaces of the little pieces; and in the same way the whiteness of snow is due to reflections from the minute crystals of which it is composed.

Red snow and green snow occur in regions where the snow is tolerably permanent; the red or green colour is due to the presence of minute plant organisms, *Protococcus nivalis*, a species of Alga.

Specimens of snow-crystals, as delineated by Dr. Nettis of Middleburg, are given in the accompanying plate. Dr. Scoresby, who in his account of the Arctic Regions has collected no less than ninety-six varieties of snow as the result of his own observations, has arranged them under five separate classes, of which the three leading forms are, the lamellar, the pyramidal, and the spicular. The first of these is subdivided into the stelliform, the most common of all, having six points radiating from a common centre, with parallel collateral ramifications in the same plane; the hexagonal, of which representations are given in figs. 10 and 11; the aggregate hexagonal, shown in figs. 12 and 13; and the hexagonal, combined with radii or spines and projecting angles, specimens of which are afforded in figs. 14 and 15. Examples of the pyramidal form are exhibited in figs. 16 and 17, and of the spicular, where one or both of the extremities are attached to the centre of a lamellar crystal, in figs. 18-20.

**SNOW**, a vessel equipped with two masts resembling the main and fore masts of a ship, and a third small mast, just abaft the main-mast, carrying a sail nearly similar to a ship's mizzen. The foot of this mast is fixed in a block of wood, or kind of step, upon the deck, and the head is attached to the after-part of the main-top.

**SNOWBALL-TREE**, or **GUELDER-ROSE** (*Viburnum opulus*—natural order, Caprifoliaceae). In the wild state the flowers of this shrub are disposed in terminal corymbs, and the outer ones are much larger than the others. They are succeeded by small red globular berries, of a disagreeable flavour. A variety which is cultivated in the gardens has all the flowers large, which gives to the corymbs the appearance of large white balls, and is a highly ornamental plant. These flowers are mostly barren. The Guelder-rose is found wild in most parts of Europe; and the variety above mentioned is of easy culture.

**SNOWBERRY** (*Symphoricarpos racemosus*, natural order Caprifoliaceae), a North American plant, commonly cultivated in shrubberies and lawns in this country. The flowers are produced in a loose and somewhat leafy spike at the end of the branches; the corolla is bearded inside; the leaves are ovate; and the berries are large and bright white, ripening in autumn. The species of this genus are readily increased by cuttings, planted in autumn or spring, or by suckers.

**SNOW-BUNTING**, **LAPLAND BUNTING**, or **SNOW-FLACK** (*Plectrophanes nivalis*), a genus of Plovers or Insectorial Birds, belonging to the sub-

family of the Emberizidae or Buntings, which group in turn is included in the family Fringillidae of the Conirostral Perching Birds. The genus *Plectrophanes* possesses a short bill, which appears to advance on the forehead. The wings have the second and third quills longest; and the claw of the hinder toe is of straight conformation. This bird in some districts also receives the names of White Lark, Pied Finch, and Mountain Bunting. It is common in the northern regions of both hemispheres, and visits Britain in flocks during the winter, arriving earlier or later according to the severity of the season. Some of these birds remain and breed in the extreme north of Scotland, but the majority prefer more northern regions. They haunt the open, treeless wilds, and place their nests on the ground or in the crevice of a rock. The eggs number five, and are of white colour, spotted with brown. Their long hind claws serve to distinguish them from the true buntings, giving them a certain similarity to the larks, which they also resemble in running swiftly and in never perching. They are brought by the north-east winds to this country, and on their arrival are lean and exhausted; but they soon become fat. In winter the plumage of the male is of a pure white colour, with the exception of the dark brown back and part of the wings; but in some cases a pure white constitutes the total plumage. The summer dress exhibits a tawny brown hue, spotted with white, the back being of a black colour. The average length is about 7 inches. The males are said by Mudie to be most sensitive to heat and the females to cold. In America Wilson says that it appears in the Northern States in December. The song is sweet, but of faint character; but when alarmed these birds utter screaming sounds. The Laplanders account the flesh of these birds a great delicacy; and in Greenland they are caught and dried in great numbers. The food consists of seeds of various kinds.

It must be also noted that the name Snow Bird is also given to the *Fringilla hyemalis* of America, which attains an average length of about 6 inches, the male bird being coloured brown on the upper parts, head, and neck, and a snowy white on the breast and belly. These birds have a very wide range of *habitat* in the New World, and migrate northwards in spring. In winter they become very tame and domesticated. They appear to be of gregarious habits, feeding and building their nests in small flocks.

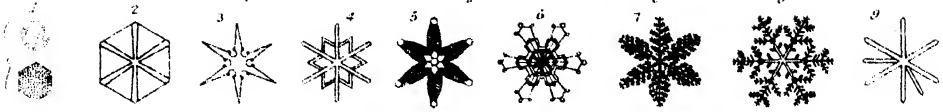
**SNOWDON**, a mountain range in North Wales, stretching N.N.E. to S.S.W. across Carnarvonshire, from the mouth of the Conway to Tremadoc, near the northern extremity of Cardigan Bay; length, about 24 miles; average breadth, 6 miles. It attains its greatest height in Snowdon proper, whose loftiest summit—Wyddva, 3560 feet—is the culminating point of South Britain. The descent of the range is gentle on the east, and precipitous on the west; and its nucleus, composed of primitive rocks, is flanked by beds of slate and limestone. An electric railway to the summit was completed in 1895.

**SNOWDROP** (*Galanthus*), a genus of plants belonging to the natural order Amaryllidaceae. The perianth is six-parted, the three outer segments spreading, the three inner short, erect, and notched at the summit. The Common Snowdrop (*G. nivalis*) has white drooping flowers, with the inner segments greenish. It is a native chiefly of the South of Europe, and has probably been introduced as a garden flower into Great Britain. It now grows wild in thickets and pastures, and blossoms in February and March.

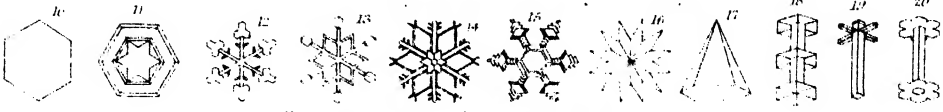
**SNOW-LINE**, the line on a mountain's side above which snow is perpetual. On looking at snow-capped

# SNOW, HAIL, DEW, HOAR-FROST, ICE.

*Crystals of Snow delineated by Dr. Xaui of Middlebury, 1740*



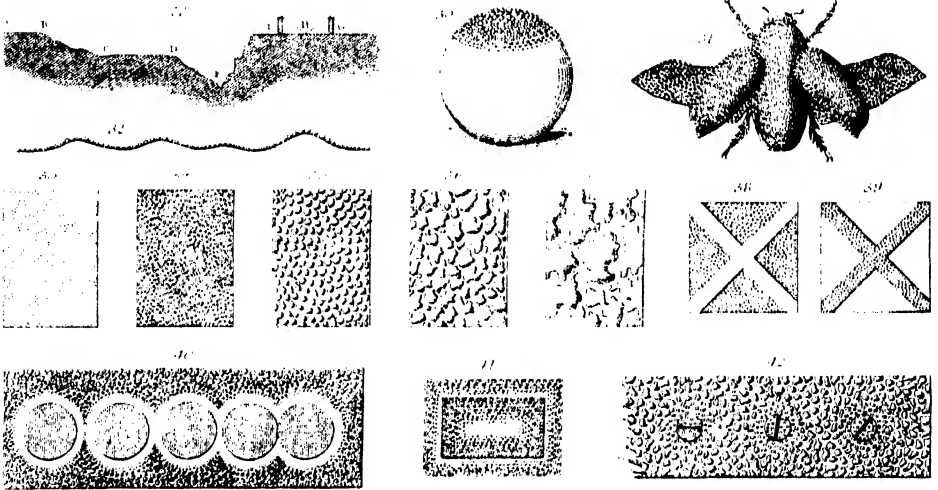
*Varieties of Snow, figured and classified by Dr. Scoresby*



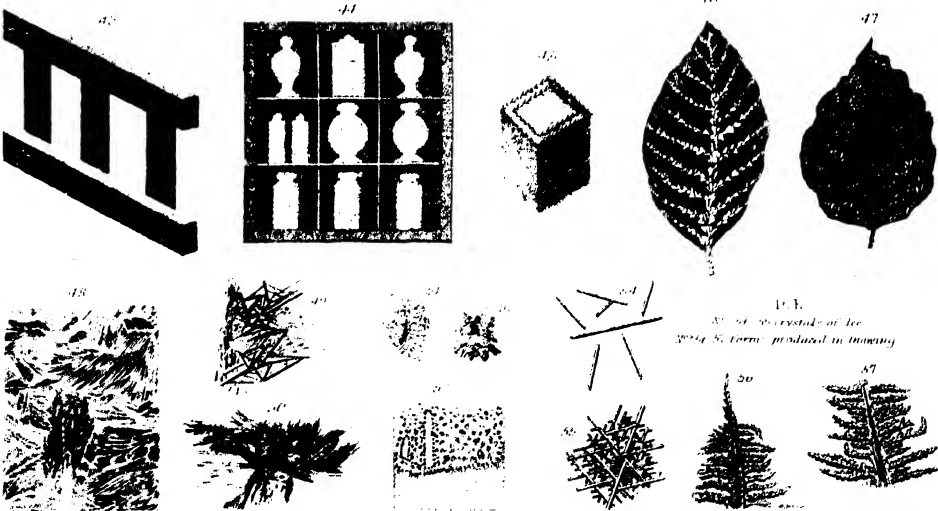
*Varieties of HAIL. No. 1 to 20. Plate sections*



*DEW under various conditions*



*HOAR-FROST under various conditions*



*ICE. No. 58, 59, crystals of Ice, giving 58 forms produced in thawing*



mountains from a distance, in the month of October, the snow will be seen to terminate in a tolerably regular (as to elevation) edge, which may be taken as the snow-line. Owing to the shape of the mountains fringes and long streaks appear below this line, and glaciers may be seen very far below it. The snow-line may be higher on one side of a mountain than the other; a great variety of circumstances affect it: it will probably be lower on a part having a northern aspect than where the aspect is southern. As might be expected, the snow-line is high on mountains near the equator. Appended is a table from Buchan's Handy Book on Meteorology, giving various snow-lines:—

PLACE.	Latitude.	Height in Feet.
Spitzbergen,.....	78° N.	0
Sulitelma, Sweden,.....	67° 5'	3,835
Kamchatka,.....	59° 5'	5,249
Unalashka,.....	56° 30'	3,510
Altai,.....	50°	7,024
Alps,.....	46°	8,885
Caucasus,.....	43°	11,063
Pyrenees,.....	42° 45'	8,950
Rocky Mountains,.....	43°	12,487
North Himalaya,.....	29°	19,500
South Himalaya,.....	28°	15,500
Abyssinian Mountains,.....	13°	14,045
Purace (Colombia),.....	2° 34'	15,381
Nevados of Quito,.....	0°	15,820
Arequipa, Bolivia,.....	16° S.	17,717
Pachata, Bolivia,.....	18°	20,079
Portillo, Chili,.....	33°	14,713
Cordillera, Chili,.....	42° 30'	6,010
Strait of Magellan,.....	53° 30'	3,707

SNOW-SHOES, a kind of shoe worn by the North American Indians, Laplanders, and other residents of high northern territories. They are light maple frames of elliptical shape, rounded off in front, and terminating in a long point behind, 3 to 4 feet in length, and from 1 foot to 1½ foot broad across the middle. The central portion included within the curved outer frame is filled in with a stiff net-work of deer's hide or beaver's or moose's skin cut into thongs. A cross piece of wood in front serves as a support for the ball of the foot, which is fastened to the shoe by thongs brought up round it. The feet of the person using the shoes are encased in moccasins of buckskin, sufficiently wide to admit three or four thicknesses of blanketing, which is not only used for keeping the feet warm, but also to prevent the toes from being chafed by the thongs which are passed over them. In walking with them the foot is necessarily thrown outward with a swinging motion, which it takes some practice to acquire. They are especially useful upon the light crust that often covers the deep snows of the northern regions, and shod with them the hunter easily overtakes the deer and moose, whose pointed feet sink through the snow and prevent the animal from running. Highly ornamented snow-shoes are made by the young women of Labrador and given to their lovers as a present. The shoes worn by the females are not so large, and are of a different shape.

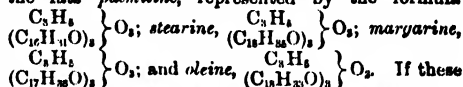
SNUFF, a powder prepared from tobacco for the purpose of being inhaled into the nose as a stimulant. The finer kinds of snuff are made of the soft portions of the best kinds of manufactured leaf tobacco, separated from the damaged portion; but the ordinary snuffs of commerce are mostly prepared from the coarser and damaged portions, the mid-ribs, stems, or stalky parts that remain after the manufacture of cut tobacco, the dust or powder sifted from the bales, and the fragments that are unfit for other purposes. The tobacco is well dried previous to grinding, and this is carried sometimes so far as to give to the snuff the peculiar flavour of the *high-dried*

snuffs. The grinding is done on the large scale by mills of different sorts, and on the small scale by a kind of pestle and mortar. During the operation the material is frequently sifted, that it may not be reduced to too fine a powder, and is several times slightly moistened with rose or orange water. In preparing the dry snuffs no moisture is added. The scent, or other like matters, are then added, and after thorough admixture the snuff is ready to be packed in kegs, jars, or canisters for the market. The moist kinds of snuff are often adulterated with ammonia, hellebore, pearl-ash, for the purposes of keeping them damp and increasing their pungency. The dry snuffs, such as the Scotch and Welsh, are commonly adulterated with quicklime, which causes their biting and desiccating effect. Snuffs are scented with musk, essences or oils of bergamot, cloves, lavender, otto of roses, orange flowers, jasmine, rose-leaves, &c. See TOBACCO.

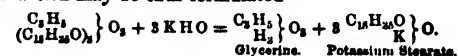
SNYDERS, SNETTERS, or SNYERS, FRANS, an eminent painter of the Flemish school, born at Antwerp in 1579, studied the rudiments of his art under Breughel and Van Bahlen, after which he is said to have travelled through a great part of Italy; but this is denied by some writers. On his return to Flanders he became attached to the household of the Archduke Albert, and finally took up his abode at Brussels. Snyder, who is considered never to have been surpassed in his delineation of beasts, fish, fruit, hunting-parties, &c., was accustomed to work in concert with Rubens and Jordaens; and some of the most valuable paintings of that school are their joint production. Many of his choice pieces are to be found in the collections at Munich, Vienna, and Dresden, in the Escorial, in the Louvre, and in some private English collections. His death took place in 1657.

SOAP. The cleansing properties of the substance produced by heating together natural fats and caustic alkalies have been known for a very long time; nevertheless the manufacture of soap upon the large scale dates only from about the year 1823, in which year Chevreul published his famous researches upon the animal fats. This work of Chevreul is one among many instances of the incalculable benefits bestowed on commerce by pure science. The natural fats—palmitine, stearine, oleine, &c.—are acid ethers of glycerine. Glycerine is an alcohol containing three atoms of replaceable hydrogen, its formula is  $C_3H_5 \begin{matrix} \text{O}_2 \\ \text{H}_3 \end{matrix}$ ; in

the fats these three hydrogen atoms are replaced by the radicles of various acids, chiefly of palmitic, stearic, margaric, and oleic acid, and we thus obtain the fats *palmitine*, represented by the formula



If these fats be heated with caustic alkalies they are decomposed, a union taking place between the particular acid, the radicle of which exists in the fat, and the alkali metal, while glycerine is at the same time produced; thus with stearine and caustic potash the reaction may be thus formulated—



The salt of the fatty acid so produced (in this instance potassium stearate) is called a soap. Soaps, therefore, may generally be defined as the metallic salts of the higher fatty acids; the process whereby these salts are produced from the natural fats is called *saponification*. Although we thus include under the name soap all the metallic salts of the higher fatty acids, yet in ordinary language the name is limited to the sodium and potassium salts of these acids.

Soaps are sometimes produced by treating oils with caustic alkalies; these oils often contain the higher fatty acids in the free state; they are therefore more easily saponified than the fats.

The essential parts of a soap are then (1) the alkaline metal and (2) the fatty acid which it contains; upon these two the quality of the soap depends. The processes by which soaps are produced may be divided into two classes—(1) saponification of fats (that is, of acid ethers of glycerine), and (2) saponification of oily bodies containing free fatty acids. We shall, in the first instance, briefly describe the general processes used in the manufacture of soaps, and then glance at the properties of different kinds of soap.

The materials employed in the manufacture of soap are tallow, palm-oil, cocoa-nut oil, resin, oleic acid, whale-oil, seal-oil, linseed-oil, &c., and caustic ley. The fats or oils are obtained partly from animals and partly from vegetables; the caustic ley is prepared by mixing together wood ashes (carbonate of potash) and lime, and lixiviating the mass with water, when a double decomposition takes place, resulting in the production of caustic potash and carbonate of lime. The ley is generally prepared of three different strengths, the strongest containing about 20 per cent. and the weakest 2 or 3 per cent. of alkali. A soda ley is also prepared by similarly treating carbonate of soda with lime. The soap-pan is of a somewhat conical shape; it is constructed of wrought-iron plates, rivetted together, and is generally furnished with a pipe through which steam is carried into the interior. The tallow or oil having been put into the pan, weak ley is added—potash ley if soft soap, soda ley if hard soap is to be made—and steam is blown in until a perfect emulsion is produced between the fat and the alkali; stronger ley is now added, and the injection of steam continued so as to insure active ebullition; from time to time further quantities of fat or oil and of ley are added until the pan is nearly full, care being taken that after the last addition no free alkali exists in the mixture. A quantity of common salt is now added, whereby the soap, which is insoluble in a solution of salt, is separated from the aqueous liquid in the pan. The soap floats on the surface in a granulated state; and the liquid underneath, which contains the glycerine produced in the reaction, is drawn off. The crude soap is now mixed with a further quantity of ley, the mixture again heated to boiling, and after some time common salt is again added. A soap is thus produced, having a decidedly alkaline reaction; it is removed from the pans, transferred to the cooling-frames, where it solidifies, and is then cut into bars or cakes and sent into the market. This process is modified in different particulars according to the nature of the materials used and the kind of soap which it is desired to produce. Thus by using cocoa-nut oil, and saponifying with very strong pure soda ley, a soap is produced which can take up a much larger quantity of water than ordinary soap and yet remain hard, and which is soluble in dilute solutions of common salt. This soap may therefore be used for washing in salt-water; it is known as *marine soap*. Cocoa-nut oil added to tallow before saponification enables a soap to be produced which can take up a large quantity of water. Palm-oil produces a soap which, on account of its containing a portion of the colouring matter of the oil, is generally of a more or less deep yellow colour. Resin, on account of its containing free fatty acids, is very easily saponified; but the soap thus produced takes up water so readily as to be unfit for use; but by mixing resin with tallow and saponifying an excellent and very firm soap may be produced.

The effect of the ley upon the soap is very striking. Soda ley produces a hard, compact soap, while the

soap produced by potash ley is soft and jelly-like. Soft-soap is generally prepared from whale-oil, seal-oil, linseed-oil, and tallow. Weak ley is added at first, and a moderate heat is applied until a semi-fluid, sticky mass is obtained, when stronger ley is added, and the heating continued until a drop of the soap allowed to fall upon a glass plate remains clear upon cooling. The heat is now increased, and part of the water driven off, until the soap has attained a semi-solid condition; salt cannot be added to separate the soap, because it would then be converted into hard soda soap. The semi-solid mass is removed from the pans and packed in casks.

*Silicated soaps* are produced by mixing silicate of sodium (soluble glass) with ordinary soap; these soaps are cheaply produced, and have very considerable detergent power.

*Toilet soaps* are produced by perfuming the best ordinary curd soap with essential oils, or sometimes by saponifying lard, beef-marrow, or oil of sweet-almonds with caustic soda ley, in the cold, and perfuming the products.

*Light or floatant soap* is produced by agitating a solution of soap, to which one-fifth or one-sixth part of water has been added, until the lather has risen to a considerable height, and then transferring it to a mould.

*Transparent soap* is prepared by drying ordinary soap, dissolving it in alcohol, allowing the solution to remain at rest so long as any impurities are precipitated, decanting off the alcoholic liquid, and evaporating it until it is of such a consistency as to solidify when cooled in metallic moulds.

*Mottled soaps* are produced by mixing mineral colouring matter with the soap during a certain stage of the hardening.

The amount of fatty acids in soap varies from 60 to 70 per cent.; of water, from 20 to 30 per cent.; and the proportion of alkaline bases, from 8 to 9 per cent. These numbers may be taken as a standard from which pure soaps should not very greatly differ.

**SOAP-BERRY**, the name applied to the fruit of several species of the genus *Sapindus* (natural order Sapindaceae) from their containing a saponaceous principle, so that when mixed with water they produce an abundant lather. These plants also yield a narcotico-acrid principle. The fruit is globular, as large as a cherry, inclosing a nut of a shining black colour when ripe. The pulp serves as a substitute for soap in washing linen, but is very apt to burn and destroy it if used too frequently. The nuts are very hard, black, and finely polished, and are used for beads. Formerly they were imported into Europe for waistcoat buttons, and were sometimes tipped with silver or other metals. They were very durable, as they do not wear, and seldom break. The whole plant, especially the seed-vessel, being pounded and steeped in ponds or rivulets, is observed to intoxicate and kill the fish. The wood is white, and full of a gum, in odour and taste resembling copal. The flowers are disposed in terminal and branching panicles, and the berries are pendulous.

**SOAP-STONE**, a species of steatite. The name is derived from its colour, and from the peculiar unctuous sensation which is experienced when the mineral is rubbed between the hands. See **STEATITE**.

**SOAP-WORT** (*Saponaria*), a genus of plants of the natural order Caryophyllaceae; so called because the bruised leaves produce a lather like soap when agitated in the water. It has a 5-toothed calyx, naked at the base, 5 undivided long-clawed petals, 10 stamens and 2 styles, and a capsule opening at the top by 4 valves. *S. Calabrica* has numerous small pink flowers; it is one of the most elegant flowers in our gardens, and is well adapted for

edgings and rock-work. Common soap-wort (*S. officinalis*) is a native of many parts of Europe, and is found on waysides, river-banks, and thickets; in Britain it is found in alluvial meadows and under hedges. Both the root and the leaves contain saponin, and are therefore frequently used for washing. The flowers are either single or double, and of a rose or pink colour; the double variety is esteemed as an ornament to the flower border, but should be planted in pots, as its roots have a tendency to spread underground like those of couch. The roots have medicinal properties, being aperient, resolvent, and alterative.

SOBIESKI, JOHN. See JOHN III. (SOBIESKI).

SOBRAON, a village on the left bank of the Satlej, 50 miles S.S.E. of Lahore, is noted as the scene of a great battle on 10th February, 1846, between the Sikhs, numbering 30,000 men, and the British forces, 15,000 strong, under Lord Gough, in which the entrenchments of the former were forced, and they themselves driven across the river with immense slaughter. In consequence of this victory the left bank of the river was cleared of the Sikh army, and the British crossed the Satlej and entered the Panjab.

SOCAGE, or SOCCAGE, in its most extensive signification, seems to denote a tenure by any certain and determinate service. And thus old writers constantly put it in opposition to tenure by knight service, which was uncertain. It is of two sorts—free socage, where the services are not only certain but honourable, and villein socage, where the services, though certain, are of a baser nature. Socage tenures are unknown in Scotland, and are supposed never to have existed there.

SOCATOO. See SACKATOO.

SOCIAL INSECTS, the name applied generally to the species of Bees, Wasps, Hornets, Ants, White Ants or Termites, &c., which live in communities, and evince in the order of their life a close and deceptive analogy to societies of mankind. If, however, we compare the automatic actions of the Social Insects with those of the higher Vertebrate, we see at once that the higher specialization of the nervous system in the latter endows it with that *appreciative intelligence* which is entirely wanting in the insect; whilst to this intelligence we may add the no less distinctive condition of the power of *volition* or *will* seen in the Vertebrate. Impressions made by the surrounding circumstances of its life upon the nerve-centres of the insect impel it to execute certain actions determined wholly by the degree or kind of the impressions. Such impressions thus lead the being to perform what are accordingly termed *sensory-motor* acts, and these most nearly approach in character to movements of an automatic kind. Where the relation between the surroundings or impressions and the acts they determine is of a fixed and stable kind, and where such acts are repeated through inheritance and descent amongst communities of animals, we have constituted that remarkable development of *instinct* seen in the social insects. The actions of these latter, however intelligent they may appear, thus consist of *sensory-motor* movements alone. Neither reason nor intelligence participate in their execution. The same series of actions and labours is undertaken by generation after generation of these insects, without training and without the educative power known as *experience*, which operates in the case of higher animals.

SOCIALISM, the name applied to various theories of social organization having for their common aim the abolition of that individual action on which modern societies depend and the substitution of a regulated system of co-operative action. The word *socialism*, which originated among the English com-

munist, and was assumed by them to designate their own doctrine, is now employed in a larger sense, not necessarily implying communism, or the entire abolition of private property (see COMMUNISM), but applied to any system which requires that the land and the instruments of production should be the property, not of individuals, but of communities, or associations, or of the government. Forecasts of later socialistic developments are to be found in Plato's Republic, More's Utopia, Harrington's Oceana, and other similar works; but the movement as a practical one may be traced to the eighteenth century, and the forces which operated to bring about the French revolution. To the earlier part of the nineteenth century belong the important schemes and experiments of St. Simon, Fourier, Owen, Louis Blanc, and Proudhon (see articles under these names), but the forms of socialism which they advocated have been to some extent superseded by the influence of later German writers. Of these Frederick Lassalle (1825-64) was one of the earlier, as he certainly was one of the most striking and romantic figures; and his statement that the day of the fourth estate had dawned, when the estate of the workmen should supplant that of the bourgeois, has been in some sense the watchword of German socialists. A second prominent name is that of Karl Marx, whose work, *Das Capital* (1867), became the text-book of socialism, and who, like Lassalle, looked for the achievement of his ends by revolution rather than by reformation along the slower lines of co-operation advocated by Schulze Delitzsch and Rodbertus. Under the guidance of the annual socialist congress, an active propaganda has been maintained in Germany with almost startling success. Numbers of socialist newspapers and organizations sprang up, and numerous socialists were returned to the German parliament; and though stringent repressive measures have been enforced, the socialistic element has become an appreciable power in the state. In England also the socialist body has steadily grown under the leadership of William Morris, Hyndman, and others. The change has operated not amongst workmen and eccentric philanthropists merely, but has received the cautious sanction of many economists. Mill went far in this direction, holding that a socialistic organization will in a possibly remote future supersede the capitalistic regime; and the younger schools of German and English economists have shown themselves in sympathy with it as at least a high speculative ideal.

The objection ordinarily made to the socialist system that each person would be incessantly occupied in evading his fair share of the work points undoubtedly to a difficulty, which may however not prove insuperable. Those who urge this objection forget to how great an extent the same difficulty exists under the system on which nine-tenths of the business of society is now conducted. The objection implies that honest and efficient labour is only to be had from those who are themselves individually to reap the benefits of their own exertions. But it should be remembered that only a very small part of all the labour performed in this country, from the lowest paid to the highest, is done by persons working for their own benefit. A factory operative has less personal interest in his work than a member of a socialist association, since he is not, like the latter, working for a partnership of which he is a member; and it must be remembered that in a socialist farm or workshop each labourer would be under the eye, not of one master, but of the whole community. In the extreme case of the obstinate shirking of the due share of work the community would have the same resources which society now has for compelling conformity to the necessary conditions of the association.

It is, moreover, an admitted condition of the socialist scheme that all shall be educated, and, this being supposed, the duties of the members of the association would doubtless be as diligently performed as those of the generality of salaried officers in the middle or higher classes. Mankind too are capable of a far higher amount of public spirit than the present age is accustomed to suppose possible. History bears witness to the success with which large bodies of men may be trained to feel the public interest their own; and no soil could be more favourable to the growth of such a feeling than a socialist association, since all the ambition and the bodily and mental activity which are now exerted in the pursuit of separate personal interests would require another sphere of employment, and would naturally find it in the pursuit of the general good of the community.

It has also been objected that the practical effect of successful socialism would be to encourage an increase of population sufficient to swallow up all its theoretical increase of production, and to result in speedy poverty and starvation. But this is not a strong objection. Any augmentation of numbers which diminished the comfort or increased the toil of the community would then cause (which now it does not) immediate and unmistakable inconvenience to every individual in the association—inconvenience which could not then be imputed to the greed of employers or the unjust privileges of the higher classes. In such altered circumstances opinion could not fail to reprobate, and if reprobation did not suffice, to repress by penalties of some description this or any other culpable self-indulgence at the expense of the community.

By far the greatest difficulty is that of fairly apportioning the labour of the community among its members. Who is to judge how much cotton spinning, or distributing goods from the stores, or brick-laying is equal to so much ploughing? To the poet, the historian, and the man of science, books and the appliances of study are as much necessities as meat and drink are to the labourer. The same quantity of work too is an unequal burden on the weak and the strong, the dull and the intelligent. How then, when talents and wants are so widely different, are they to be applied and rewarded justly?

It cannot be denied that the general result of a historical survey of socialist systems and the various attempts to carry them into practice will be a conviction of failure, relieved only by partial successes. The greater part of this failure is certainly to be attributed to the present imperfect state of moral and intellectual cultivation and to the want of practical knowledge on the part of the leaders of the movement. It would perhaps be rash to pronounce the best of the systems incapable of success or unfitted to realize a great part of the hopes founded on them by their partisans. Meanwhile socialism has done good service by calling attention to the defects of our boasted civilization, and thus has led to a study of the means by which to remedy them. Although socialists have never yet succeeded in overturning the reign of individualism they have usefully shown that combination is capable of many things to which isolated action could never attain. See Blanc's *L'Organisation du Travail*; Marx's *Das Capital*; Schäffle's *Quintessence of Socialism*, and *Impossibility of Social Democracy*; Hyndman's *Historic Basis of Socialism in England and Economics of Socialism*; Rae's *Contemporary Socialism*; Kirkup's *Inquiry into Socialism*, and *History of Socialism*; W. Graham's *Socialism, New and Old*; S. Webb's *Socialism in England*; Engel's *Socialism, Utopian and Scientific*; Fabian Essays; Flint's *Socialism*; Naquet's *Collectivism and Socialism*; &c.

**SOCIAL SCIENCE ASSOCIATION.** See NATIONAL ASSOCIATION FOR THE PROMOTION OF SOCIAL SCIENCE.

**SOCIETY ISLANDS**, in some respects the principal group of the South Pacific, between lat. 16° 11' and 17° 53' s., and lon. 148° and 155° w.; and between the Low Islands, which almost join them on the east, and the Friendly Islands, situated at a greater distance on the west. The group consists of the principal island of Tahiti or Otaheite, which is about 32 miles long north-west to south-east, and is divided into two peninsulas by an isthmus about 3 miles broad; and a great number of comparatively small islands, of which the most deserving of notice are Eimeo or Moorea, Maitea, Tetuaroa, Maiaoiti or Saunder's Island, Tahaa or Otaha, Maurua or Maupiti, Tubai or Motu-Iti, Huahine, Raiatea or Uliatea, and Bora-Bora, all being under French rule. Though at a considerable distance, the Low Islands, Marquesas, and Tubuai groups are ruled in connection with them. All the islands are elevated, and more or less mountainous. In Tahiti, which consists of an elongated ridge, the loftiest summit, Orohena, is 7339 feet above the sea, and two other summits near it are respectively 7323 feet and 6675 feet. Among the mountains, remarkable for their magnificent scenery, are many deep valleys and romantic glens, in which a delightful climate and fertile soil maintain a luxuriant vegetation. The scenery of Eimeo is, if possible, still more attractive than that of Tahiti; and almost every island of the group has been described by navigators in rapturous terms, as realizing their ideas of an earthly paradise. The Society Islands appear to have been first discovered in 1606 by the Spanish navigator Pedro Fernandez di Quiros, who gave to Tahiti the name of *La Sagittaria*. It remained unknown to the rest of the world till 1767, when Captain Wallis, sent by George III. to make discoveries in the Pacific, reached Tahiti, and believing himself the first discoverer gave it the name of King George Island. The year after it was touched at by Bougainville; but by far the most important visit was that of 1769, made by Captain Cook, in company with Sir Joseph Banks and an efficient scientific staff, mainly for the purpose of observing the rare occurrence of the transit of Venus across the sun's disc. On this occasion Captain Cook, besides surveying the chief island, discovered several of the north-west group, and gave to the whole the name of Society Islands in honour of the Royal Society of London. These discoveries excited the deepest interest in Great Britain, and one of its most important fruits was the formation of the London Missionary Society, which fitted out a vessel to carry out missionaries and the blessings of Christian civilization. The result was successful beyond expectation. The great body of the natives abandoned their abominable practices, threw away their idols, and had been formed into regular Christian communities, when the Catholics, envying the Protestant success, sent two French priests for the avowed purpose of sharing in the evangelical harvest. The unwillingness of the natives to receive them easily furnished a colour for a complaint of ill usage, and the French government, anxious to turn their complaints to good political account, robbed the natives of their independence by first establishing a protectorate in 1844, and then by turning the islands into a colony in 1880. Under French administration neither Christianity nor morality is said to have made satisfactory progress. Pop. 18,000.

**SOCINIANS.** See SOCINUS and UNITARIANS.

**SOCINUS**, the Latinized name of two celebrated theologians, uncle and nephew, who have given name to a religious sect, the Socinians, whose modified doctrines are now popularly known as Unitarianism.

**LAELIUS SOCINUS (LELIO SOZZINI)** was born in 1525 at Siena, in Tuscany. He was destined for the legal profession, in which his father, Mariano, and several others of his ancestors, had gained considerable distinction; but, moved by the religious discussions which then agitated the greater part of Europe, he abandoned the science of jurisprudence for the study of the Scriptures. In order to prosecute his study thoroughly he mastered the Greek, Hebrew, and Arabic languages. In 1546 he was admitted a member of a secret society at Vicenza, consisting of forty persons, which had been formed for the discussion of religious questions. They soon arrived at the conclusion that the doctrine of the Trinity was untenable, and that many of the dogmas of the Catholic Church were repugnant to reason, which they held to be the only court of appeal in matters of religion. The nature of their deliberations having become known the society was broken up, several of its members were arrested and put to death, and others, among whom was Socinus, left the country. He visited France, England, and Holland, and resided for some time in Switzerland, Germany, and Poland, where he found many persons who were in sympathy with his views. He finally settled in Zürich, where he died in 1562. He was an accomplished oriental scholar, an acute Biblical critic, an able disputant, fearless in his spirit of inquiry, yet prudent and reticent. He is the author of *Dialogus inter Calvinum et Vaticanum*, *De Sacramentis*, *De Resurrectione Corporum*, and several unfinished works, which he bequeathed to his nephew Faustus.

**FAUSTUS SOCINUS (FAUSTO SOZZINI)**, nephew of the preceding, was born at Siena in 1539. Having lost his parents while still young his education was but carelessly superintended. The letters which his uncle sent to his family occasioned many private discussions, in which Faustus took an active part at a very early age. He was obliged to leave Siena from suspicions of his entertaining heretical notions as early as in his twentieth year, and retired to Lyons. On the death of his uncle he came into possession of the manuscripts of the latter, by the study of which he found his former opinions confirmed. He began to publish his views at Florence (where he lived twelve years at the court of the grand-duke, Francesco de' Medici) in anonymous writings; and he afterwards retired to Basel to avoid the persecutions of the Italian inquisition. His opinions were still more fully developed during a residence in Transylvania, and in Poland he had numerous adherents. The Anti-Trinitarian societies in that country, although they agreed with him in some points of doctrine, yet differed so far in others that they would not receive him into their communion. He formed, however, some small societies of followers there, but suffered persecution in that country, and the confiscation of his property in Italy. His death, which was hastened by the brutal treatment of a fanatical Cracovian mob, took place at the village of Luclavie, in Poland, in 1604. See **UNITARIANS**.

**SOCK** (*soccus*), a sort of low shoe or loose slipper, worn by the Greeks, and also by the Roman women, who had them highly ornamented. They were likewise worn by comic actors, the buskin, or cothurnus, being used in tragedy. *Sock* is hence often used for comedy.

**SOCORRO**, a town of the S. American republic of Colombia, capital of the department Santander, in a very hot and unhealthy district, 150 miles N.E. of Bogotá. It is for the most part poorly built, and has manufactures of cotton goods and straw hats, and a considerable trade with the surrounding districts; pop. 16,000.

**SOCOTRA**, an island in the Indian Ocean, about 150 miles N.N.E. of Cape Guardafui, and 71 miles long by 22 miles broad; area, over 1000 square miles. The shores are generally bold, but on the north there are several bays capable of affording tolerable shelter to vessels. The only fertile portions are in the east and north. The principal natural production is aloes, said to be the finest in the world. In Feb. 1876, the British concluded a treaty with the owner of the island, the Sultan of Keshin, engaging him not to cede it to any foreign power, or to permit any settlement without the sanction of the British government. In 1886 it was finally annexed by Britain. The inhabitants, about 4000, are a mongrel race of aborigines and Bedouin Arabs.

**SOCRATES**, the celebrated Greek philosopher, was born at Athens, in 469 B.C., or perhaps a year or two earlier. His father, Sophroniscus, was a sculptor, and Socrates himself followed this occupation for a time; and tradition ascribed to his chisel three draped figures of the Graces which in the time of Pausanias (about 150 A.D.) stood at the entrance to the Acropolis. His mother, Phænarete was a midwife, and he said of himself that he practised her art when he drew out the ideas of his disciples into the light of day. In his youth he received the education prescribed by the laws, and also made himself acquainted with geometry and astronomy. That he had listened to Anaxagoras or Archelaus is only reported by untrustworthy authorities; Plato accounts for his master's acquaintance with the works of the former by supposing that he had read the work written by that philosopher. According to Xenophon he was familiar with the doctrines of other natural philosophers, although he did not accept them. Plato represents Socrates as saying that, while still very young, he met Parmenides, the most important of the Eleatic philosophers, who was then advanced in years, as the latter was expounding his doctrines. A material influence on his philosophical development was exercised by the Sophists, to whose discourses he occasionally listened, and with whom he frequently entered into conversation. Excepting in connection with his philosophical career, only a few circumstances of his life are known. He served as a hoplite or heavily armed soldier in the campaign of Potidea (432-429 B.C.), where he excelled his fellow soldiers in the ease with which he endured the hardships of a winter campaign, distinguished himself by his valour, saved the life of his friend Alcibiades, and resigned to that youth the prize of honour which was awarded to his own bravery. He fought at the battle of Delium (424), and according to one account saved the life of Xenophon, while according to another his own retreat was protected by Alcibiades. In 422 he marched with Cleon against Amphipolis. On two memorable occasions he came boldly to the front in political life. After the battle of Arginusæ (406) ten naval officers were publicly arraigned for neglecting the sacred duty of burying the slain in consequence of a violent storm. The clamour for their condemnation rose so high that the court wished to proceed in violation of all legal forms; but Socrates, the presiding judge on that day, refused to put the question. He soon after showed that he could withstand tyrants as well as the populace. He was summoned by the Thirty to proceed with four other persons to Salamis to bring back Leon, an Athenian citizen who had retired thither to escape the cruelty and rapacity of the new government. He alone refused, while the others obeyed the order. He declined taking further share in public affairs, giving as a reason the warnings of an internal voice, a divine Mentor, of which he was wont to speak.

In the writings of the disciples of Socrates he

appears almost always as a man advanced in years, such as they themselves had known him. With remarkable physical strength and endurance, he trained himself to coarse fare, scanty clothing, bare feet, and indifference to heat or cold, aiming thus to reduce the number of his wants, as a distant approach to the perfection of the gods, who want nothing. He had a flat nose, thick lips, prominent eyes, bald head, squat figure, and ungainly gait, so that Alcibiades likened him to an uncouthly sculptured Silenus containing within the images of the gods. He brought into thorough subjection his naturally impetuous appetites and irascible temper, and has been called the most illustrious example in history of the moral conscience, and the creator of moral science. But though a sage he was wholly removed from the gloom and constraint of asceticism; he indeed exemplified the finest Athenian social culture, was a witty as well as a serious disputant, and on festive occasions would drink more wine than any other guest without being overcome. Of his wife Xanthippe, all that has passed into history is that she bore him three sons, that she was an arrant shrew, and that he married and endured her for self-discipline. His daily life is thus sketched by Grote in his *History of Greece*. Early in the morning he frequented the public walks, the gymnasia for bodily training, and the schools where youths were receiving instruction; he was to be seen in the market-place when it was most crowded, among the booths and tables where goods were exposed for sale. His whole day was usually spent in this public manner. He talked with any one, young or old, rich or poor, that sought to address him, and in the hearing of all those who chose to stand by. He visited all persons of interest in the city, male or female; his friendship with Aspasia is well known; and one of the most interesting chapters of Xenophon's *Memorabilia* recounts his visit to, and dialogue with Theodoté, a beautiful hetæra, or female companion. Nothing could be more public, perpetual, and indiscriminate as to persons than his conversation; and, as it was engaging, curious, and instructive to hear, certain persons made it their habit to attend him in public as companions and listeners. These men, a fluctuating body, were commonly known as his disciples or scholars, though neither he nor his personal friends ever employed the terms teacher and disciple to describe the relation between them. Among the most distinguished of his companions were Plato, Xenophon, Crito, Euclid of Megara, Antisthenes, Aristippus, Phædon, Æschines, Cebes, and Alcibiades. He devoted his life especially to the education of youth, and for the accomplishment of this end he relied on *erôs*, love, which, without excluding its sensuous element, he refined and utilized as an instrument in the conduct of souls and the common development of his thoughts and those of his listeners.

Socrates was firmly convinced that he was charged with a special religious mission. He believed he was called by the Deity to strive, by means of his teaching and life, after a revival of moral feeling, and the laying of a scientific foundation for it. For this reason he had been warned against participating in public affairs by the internal divine voice already mentioned. Relying, too, like his countrymen, on divine intimations by dreams and oracles, he believed that his mission had been signified to him by these. One oracular deliverance in particular he described as the turning-point in his career. A friend of his named Chærephon, about the time when he began to have some repute as a sage, consulted the Delphic oracle as to whether any man was wiser than Socrates, and received the reply, 'None.' This reply perplexed Socrates very much; it came from an authority which

he deemed infallible, yet he was conscious that he had no wisdom on any subject whatever. He at last determined to put the matter to the test by measuring the wisdom of the recognized leading spirits of the time. He obtained an interview with a prominent politician, accounted wise by himself and by others, and after a severe questioning came to the conclusion that the politician's reputation was far from being deserved. He then attempted to convince the politician of his defective knowledge, but did not succeed. This opened up to him the meaning of the oracle: his superiority to others did not consist in his wisdom, but in his consciousness of his ignorance. He extended the same experiment to other politicians, to rhetors, poets, artists, and artisans, with a like result. He therefore deemed it his duty to examine men of all degrees as to their knowledge, to convince them of their ignorance, and thereby put them in the way of becoming wise. This severe system of cross-questioning must have deeply wounded the vanity of many, and as the philosopher did not seek to disguise his contempt for those in power he raised up against himself many formidable enemies. Aristophanes, in his comedy of *The Clouds* (first represented in 423), attributes to Socrates not only traits of character and opinions which really belonged to him, but also Anaxagorean doctrines and sophistical tendencies. The ground of the possibility of this misapprehension, or, if the expression is preferred, of this poetic license, is to be found on the part of Socrates, not only in the fact that he stood, as a philosopher, in a certain antagonism to the general popular consciousness, and that the Anaxagorean theology had not remained without influence on him; but more especially in the fact that, as a philosopher whose reflection was directed to the subjective processes and phenomena, and who made action dependent on such reflection, he moved in the same general sphere with the sophists, only differing from them by the peculiar direction or kind of his philosophizing. On the part of Aristophanes it is to be found in the fact that he, as a poet and not as a philosopher, and (so far as he is in earnest in his representations) as an anti-sophistical moralist and patriotic citizen of the old school, with strong convictions of the immorality and dangerousness of all philosophy, scarcely considered the significance of specific differences among philosophers as worthy of his attention, not to say was unable to appreciate their essential importance.

In 399 B.C. formal accusation was brought against the philosopher in the following terms:—'*Socrates is guilty of crime, first, for not worshipping the gods the city worships, and for introducing new divinities of his own; next, for corrupting the youth. The penalty due is death.*' These are virtually the same charges as were laid against him by Aristophanes more than twenty years earlier. His accusers were Meletus, a young dramatic poet, little known, and personally almost a stranger to Socrates, and who is said to have joined in the accusation because he felt himself injured by Socrates's demonstration of the ignorance of poets respecting their art; Anytus, a rich leather-dealer and influential demagogue, who was displeased with the depreciatory judgment of Socrates respecting the Athenian statesmen and politicians; and Lycon, a public orator, who felt injured by what Socrates said of the orators. The trial took place before a *dikaastery*, or law-court composed of citizen judges, like our juries, but far more numerous; the number present on this occasion has been variously set down at 500, 501, 557, and 567. His bold defence, which appeared to his judges as presumptuousness, is preserved by Plato, under the title of the *Apology of Socrates*. He dwelt on his mission to convict men

of their ignorance for their ultimate benefit; declared himself a public blessing to the Athenians; assuring them if his life was spared he would continue in the same course; and regarded the approach of death with utter indifference. To his judges his philosophical reflections seemed a violation of those ethical and religious foundations of the Athenian state, which the restored democracy were endeavouring to re-establish. The former intimacy of Socrates with Alcibiades, and with the hated tyrant Critias, led to a mistrust of his doctrines and purposes. Yet the condemnation was voted by only a small majority, some read three and others thirty. But since after his condemnation he would not acknowledge himself guilty, by expressing an opinion as to the punishment he should receive, but declared himself worthy, on the contrary, of being fed at the Prytaneum as a benefactor of the state, and at last only on the persuasion of his friends agreed to a fine of thirty minas, he was condemned to death by an increase of eighty votes. The execution had to be delayed thirty days, until the return of the sacred ship which had been sent to Delos on the periodical Theoric mission. Every morning his wife and three sons, together with his companions and friends, assembled in his cell, and he conversed with them as he had been wont to do. In his solitary hours he composed a hymn to Apollo, and versified several of the fables of Æsop, his first attempts at poetical composition. His friends formed projects for his escape, and Crito, his old and tried friend, undertook to persuade him to comply with their wishes. He considered it, however, his duty as a citizen to obey the laws, though they were badly administered, and would not consent. Early on the morning of the fatal day his wife and friends met in his cell to spend the last hours with him. Xanthippe was much affected, and showed her grief by loud cries; Socrates made a sign to Crito to have her removed, as he wished to spend his last moments in tranquillity. He then talked with his friends, first about his poem, then concerning suicide, and at last on the immortality of the soul. The manner in which the assembled friends, in the alternation of joyful admiration and profound grief, lauded him as one who, by the divine appointment, was going to a place where it must fare well with him, if with any one; how he departed from them with the one wish, that in their care for their true welfare they would cherish in their memories all his sayings; and how he designated the transition to the life beyond death as the true recovery from a state of impurity and disease, is set down in lively and affecting colours by his great disciple Plato, in the dialogue *Phædo*. The approach of twilight at length admonished them that the hour had come. He took the hemlock cup, calmly and slowly drank the poison. He then walked up and down the apartment, trying to console his weeping friends. When it became difficult to walk he lay down upon his couch, and before his heart ceased to beat he exclaimed: 'My friends, we owe a cock to Æsculapius.' He then covered himself up with his cloak and calmly expired. 'Thus died the man,' says Plato in his *Phædo*, 'who of all with whom we are acquainted was in death the noblest, in life the wisest and most just.'

In their accounts of the life of Socrates the two principal authorities, Xenophon and Plato, substantially agree, although the Platonic picture is sketched with the more delicate pencil. As to their reports of his doctrine, it is first of all undoubtedly true that Plato in his *Dialogues* generally presents his own thoughts through the mouth of Socrates. But in a certain sense his *Dialogues* can nevertheless serve as authorities for the Socratic teaching, as the groundwork of the Platonic philosophy is contained

in the Socratic, and as it is possible, in general, though not in all cases in detail, to discriminate between the Platonic and Socratic elements. Plato was cautious enough not to be led by his love of idealization too far from historic truth; in some of his compositions he remains almost entirely faithful to it, and in others puts those doctrines which Socrates could not have professed into the mouth of other philosophers. Xenophon wrote the *Memorabilia* and the *Symposium* not so much in the spirit of a pure historian as in that of an apologist; but his honourable defence of Socrates demands from us entire confidence in his historic fidelity, so far as his intention is concerned. But it must be acknowledged that as much cannot be said of his intellectual qualification for an exact and comprehensive understanding of the Socratic philosophy. Xenophon appears to attribute too unconditionally to Socrates the tendency natural to himself to connect all scientific activity with a practical purpose, and he thus gives too small a place to the dialectic of Socrates as compared with his ethical teachings. The brief statements of Aristotle respecting the philosophical doctrines of Socrates are very valuable, since they are purely historical, and relate to the most important points of his teaching. The previous philosophies consisted of vague speculations on nature as a whole, combining cosmology, astronomy, geography, physics, metaphysics, &c. Socrates had given much attention to these subjects, and arrived at the conclusion that the knowledge he had gained was of little practical value. Astronomy might have a certain value in navigation and in the measurement of time, and so should be learned to some extent by the pilot and the watchman; geometry was useful when confined to land-measuring; arithmetic might be useful in many of the affairs of daily life, and so on; but the speculations of philosophers, from Thales downwards, as to the origin of all things out of fire, water, air, &c., he regarded as profitless, nay, as impious even. 'Do these inquirers,' he would ask, 'think that they already know human affairs well enough that they thus begin to meddle with divine? Do they think they shall be able to raise or calm the winds at pleasure, or do they simply seek to gratify vain curiosity?' The gods managed the operations of nature after their own pleasure, and refused to submit them to invariable laws of sequence, such as could be discovered by human study; the only means of knowledge permitted was sacrifice, prayer, and the consultation of the oracles. Men's strivings after knowledge should be directed to the human relationships as involving men's practical concerns. Self-knowledge, the fulfilment of the requirement of the Delphic Apollo, 'Know thyself,' is the condition of practical excellence. External goods do not advance their possessor; to want nothing is divine, to want the least possible brings one nearest to divine perfection. Virtue is capable of being taught, and all virtue is in truth only one; no man is voluntarily wicked, all wickedness simply resulting from ignorance. The good is identical with the beautiful and the useful. Cicero's well-known saying that Socrates called philosophy down from the heavens to earth, and introduced it into the cities and houses of men, compelling men to inquire concerning life and morals and things good and evil, indicates in terms substantially correct the progress of philosophy in Socrates from the cosmology and physics of his predecessors to anthropological ethics. He possessed, however, no complete system of ethical doctrines, but only the living instinct of inquiry, and could therefore naturally arrive at definite ethical theorems only in conversation with others. We read in the metaphysics of Aristotle that Socrates introduced the method of

induction and definition which sets out from the individual and ends in the definition of the general notion. His manner of seeking out these definitions is characteristic, and links itself to his conversational method and his convicting men in general of ignorance in things that they thought they knew. Professing himself to be unable to furnish any exact definition of justice, temperance, piety, courage, &c.—this professed ignorance is called the Socratic irony—and finding everyone else confident in their ability to supply the want, he asked someone to give his definition; and on its being given he put a few further questions by way of making certain (as he said) that he fully understood the meaning, but with the inevitable result of driving the respondent into confusion or a humiliating self-contradiction. From Xenophon we learn that he would pass from this severe cross-questioning method and address to his audience plain and homely precepts, inculcating self-control, temperance, duty to parents and the state, brotherly love, fidelity in friendship, &c.—The fundamental thought in his political doctrine is that authority properly belongs to the intelligent—to him who possesses knowledge. The good ruler must be, as it were, a shepherd to those whom he rules; his business, his 'virtue', is to make them happy. Socrates did not favour the appointment of officers by popular suffrage and by lot.—He defends the belief in the existence of gods on teleological grounds, arguing from the structure of organized beings, and founding his reason on the general principle that whatever exists for a use must be the work of intelligence. The Wisdom which is present and rules in all that exists determines all things according to its good pleasure. It is distinguished from the other gods as the ruler and disposer of the universe. The gods, like the human soul, are invisible, but make known their existence unmistakably by their operations.

It is reported that soon after the death of the great philosopher the Athenians regretted their sentence, and that to expiate their crime a brazen statue, the work of Lysippus, was dedicated to his memory. Yet a more general revulsion of opinion in favour of Socrates seems first to have taken place in consequence of the labours of his scholars. That some of the accusers were put to death and others exiled is probably a fable, founded perhaps on the fact that Anytus, banished in all likelihood for political reasons, died in Heraclea, on the Pontus, where in later centuries his tomb was still pointed out.

**SODA.** The term soda is very loosely used, not only in popular language but also in technical literature. Strictly speaking it should only be applied to the oxide of the metal sodium,  $\text{Na}_2\text{O}$ , but it is often used for the hydrate  $\text{NaHO}$ , though this is more frequently called caustic soda, and very frequently for the carbonate  $\text{Na}_2\text{CO}_3$ —usually the hydrated carbonate  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ , or washing-soda, commonly known simply as soda.

**Sodium.**—All the soda compounds contain the metal sodium. Until the commencement of the nineteenth century the oxide soda was considered as an element, but in 1807 Davy succeeded in breaking it up into the metal and oxygen. Sodium is one of the alkali metals, so called because they are contained in the alkalies. Its symbol is Na (from the Latin name Natrium), and its atomic weight is 23. It is considerably lighter than water, having a specific gravity of about 0.974. It is very soft at ordinary temperatures, but at very low temperatures ( $-20^\circ\text{C}$ .) becomes much harder. It melts at about  $97^\circ\text{C}$ . and boils at between  $860^\circ\text{C}$ . and  $950^\circ\text{C}$ . It has a silver-white colour on a clean-cut surface, but tarnishes very rapidly on exposure to the air, though it is said

to be unchanged if the air be perfectly dry. Sodium is a very strongly electropositive element. It burns readily when heated in oxygen or in chlorine; it combines readily with bromine or iodine, and it absorbs hydrogen. It decomposes water at ordinary temperatures, hydrogen being evolved and caustic soda produced,  $2\text{Na} + \text{H}_2\text{O} = 2\text{NaHO} + \text{H}_2$ . The heat evolved is usually not sufficient to ignite the hydrogen unless either the water be warm or the fused globule of sodium be prevented from moving about, as by putting it on moist blotting-paper, or by thickening the water with gum. Sodium alloys readily with many metals. Owing to the readiness with which it undergoes oxidation it must be kept out of contact with air, and is therefore usually preserved under naphtha or some other liquid free from oxygen.

**Preparation of Sodium.**—Sodium is prepared on a fairly large scale, and at one time was used for the reduction of aluminium from aluminium chloride. It may be prepared by reducing the carbonate or the hydrate, or by electrolysis of the fused chloride.

(1) By the old process an intimate mixture of dry sodium carbonate, lime, and charcoal was heated in a retort, the metal was reduced, volatilized, and collected on a flat sheet-iron condenser. The yield by this process was always small.

(2) The modern process (the Castner process) consists in heating an intimate mixture of iron and charcoal with caustic soda in egg-shaped iron retorts. The caustic soda melts, but the iron intermixed with the carbon prevents this floating to the top. The metal is reduced at a red heat, distils out, and is condensed in a suitable receiver,  $6\text{NaHO} + 2\text{C} = 2\text{Na}_2\text{CO}_3 + 3\text{H}_2 + 2\text{Na}$ .

(3) The decomposition of fused sodium chloride or sodium hydrate by means of an electric current is of interest, but is not carried out commercially.

**Sodium Oxides.**—Two oxides are known—the monoxide  $\text{Na}_2\text{O}$ , and the peroxide  $\text{Na}_2\text{O}_2$ . The monoxide may be prepared by heating caustic soda,  $\text{NaHO}$ , with sodium, hydrogen being evolved. It is a gray solid, melts in a red heat, boils at a higher temperature, and combines with water with great violence.

**Sodium Peroxide.**—Sodium is carefully dried and warmed in a flask in a current of nitrogen, the nitrogen is then displaced by dry air, the flask being slowly heated up to  $200^\circ$ . At that temperature oxidation commences, and goes on rapidly, a bulky white oxide being left; the air is then replaced by oxygen, which is rapidly absorbed. It is a white powder, readily soluble in water with the evolution of heat, a little oxygen being given off. It slowly deliquesces in air, carbonate being formed. It is a powerful oxidizing agent.

**Sodium hydrate,** caustic soda,  $\text{NaHO}$ . This is a white brittle solid, which comes into the market in the form of sticks or larger masses. It melts below red heat and boils at a higher temperature without decomposition. It is very soluble in water, the solution being attended with a considerable evolution of heat. It is a very strong alkali, and combines with acids, forming salts with the elimination of water. It dissolves chlorine with the formation of a mixture of chloride and hypochlorite (bleaching-liquid). The fused salt dissolves many substances, acting as an oxidizing agent.

**Manufacture of Caustic Soda.**—Caustic soda is used on a very large scale for many purposes, and its manufacture is therefore an important industry. It may be made to be used in solution—soda-lye—or it may be made for separation in the solid condition. Solid caustic soda seems to have been first

made commercially about 1845 at the St. Rollox works, Glasgow, but it was not till 1853 that the industry became important. The usual method is to treat crude solutions of sodium carbonate with lime or other oxide or hydrate. The solutions used may be the tank liquors obtained in the process of manufacture of the carbonate, or soda ash may be dissolved in water for the purpose. As the liquors may contain sulphides these are destroyed by blowing air through the hot solution to oxidize them, or by addition of some oxidizing agent. The liquid is suitably diluted, heated to boiling, and lime is added, with constant agitation, produced by blowing in steam or air, or by mechanical agitators. Carbonate of lime is produced, which is allowed to settle. The clear liquor is run off into concentrating-pans, these being usually heated by waste heat from the furnaces; the evaporated solution is let 'settle' so that any salts may separate, and the solution is passed on to the caustic pots. These are cast-iron pots 7 to 9 feet in diameter, and holding about 10 tons of caustic. The solution is evaporated till the boiling-point reaches  $180^{\circ}\text{C}$ .—at which point it would solidify on cooling and yield caustic of 53 per cent. The boiling down is continued, great care being taken that the mass does not boil over till the required strength is obtained. When the boiling-point is  $260^{\circ}\text{C}$ . the mass will contain 66 per cent of alkali. A final oxidation is brought about by the addition of a little soda-nitre, or by blowing air into the fused mass for some hours, and when oxidation is complete a sample is taken out and tested, and if it is to be 60 per cent the necessary amount of common salt is added to reduce it to that strength. The mass is now kept hot for some hours, but is not allowed to boil, so that the impurities may separate out, and the clear white caustic is ladled into iron drums or cast into sticks, or it may, after solidification, be ground. *Cream caustic* is an inferior variety tinged with iron.

**Sodium Carbonate,  $\text{Na}_2\text{CO}_3$ .**—This is one of the most important salts of sodium, and is now manufactured on a very large scale. The normal carbonate,  $\text{Na}_2\text{CO}_3$ , is a white powder, and is prepared by heating the crystallized salt or the bicarbonate till all the water is expelled. It melts at about  $818^{\circ}\text{C}$ . with slight decomposition. Several hydrates are known; the ordinary hydrate, commonly known as washing-soda, which is generally understood when sodium carbonate (or carbonate of soda) is mentioned, is  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ . It is obtained in clear crystals by crystallizing moderately-concentrated solutions at ordinary temperatures. These crystals melt at  $34^{\circ}$ , and on heating lose water. The crystals effloresce on exposure to the air, the surface becoming covered with a white powder which is a lower hydrate, usually  $\text{Na}_2\text{CO}_3 \cdot 5\text{H}_2\text{O}$ . Several other hydrates are known, and can be prepared by crystallizing solutions under suitable conditions. The only one of any importance is the mono-hydrate,  $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ , which is prepared commercially by crystallizing boiling solutions of the salt. It is much more suitable than the ordinary soda for transport, as it contains a much smaller quantity of water.

**Sodium bicarbonate** (bicarbonate of soda—sodium-hydrogen carbonate),  $\text{NaHCO}_3$ , occurs as a white powder, and is frequently known as baking-soda from its use in baking-powders. It has an alkaline taste, but much less powerful than the normal carbonate, for which reason it is used in medicine when an alkaline carbonate is required. It crystallizes in small tabular crystals (monoclinic), and is much less soluble than the normal carbonate, so that it can be prepared by passing carbon dioxide into a strong solution of that salt. When heated it is

decomposed, water and carbon dioxide being expelled and the normal carbonate left.

**Manufacture of Sodium Carbonate.**—The manufacture of sodium carbonate is one of the most important branches of chemical industry. Until the end of the eighteenth century the salt was mainly prepared from the ashes of plants. In 1775 the French Academy offered a prize for a method of converting salt into soda, the identity of the base in the two substances having been demonstrated by Duhamel in 1736. As a result the process known from its inventor as the Leblanc process was devised. The process was put to work in France about 1791, and was first tried in Great Britain on a small scale at Newcastle in 1816, and in Glasgow in 1818, but it was not till the abolition of the salt duty in 1823 that a serious effort was made to work the process by Muspratt in Liverpool.

The process is a somewhat complex one, but the principles on which it is based may be briefly described. It consists of three distinct stages: (1) the manufacture of salt-cake, (2) the conversion of the salt-cake into black-ash (crude sodium carbonate), (3) solution and separation of the carbonate.

(1) The raw materials are common salt and sulphuric acid. These are mixed in the required proportions in a suitable furnace, and the mixture is heated till the salt is converted into sulphate, hydrochloric acid being evolved. Thus,  $2\text{NaCl} + \text{H}_2\text{SO}_4 = \text{Na}_2\text{SO}_4 + 2\text{HCl}$ . The products are thus sodium sulphate or salt-cake and hydrochloric acid. The latter is passed up condensing towers, where it is met by a descending rain of water and is thus dissolved, the solution being used for the preparation of chlorine for the manufacture of bleaching-powder.

(2) The sodium sulphate,  $\text{Na}_2\text{SO}_4$ , has now to be reduced to sulphide,  $\text{Na}_2\text{S}$ , by heating with carbon, and this converted into carbonate by double decomposition with calcium carbonate. The raw materials are, therefore, the salt-cake made in the first operation, chalk, occurring abundantly in the south of England, and coal in a fine state of division. The mixture is introduced into a furnace known as the black-ash furnace, and heated to fusion. The fused mass is thoroughly mixed, and as gas (mainly carbon dioxide) is given off, it seems to boil. As the action goes on, the mass becomes thicker, carbon monoxide is given off in place of the dioxide, and burns with its characteristic blue flame. The pasty mass is then raked into masses or balls, which are drawn through the door of the furnace into trucks. The main reactions are  $\text{Na}_2\text{SO}_4 + 2\text{C} = \text{Na}_2\text{S} + \text{CO}_2$ ,  $\text{Na}_2\text{S} + \text{CaCO}_3 = \text{CaS} + \text{Na}_2\text{CO}_3$ , but many other changes also take place.

(3) At one time the black-ash thus obtained was sent directly to the soap-makers or other consumers; now it is invariably converted into a somewhat purer form of carbonate known as *soda-ash*. The black-ash is transferred to tanks and treated with water, the large balls being broken up so as to allow of ready solution; a moderate temperature only is used and the solution is brought about as quickly as possible. The tank liquor is run into tanks, and is treated with carbon dioxide either by passing the gas over or through the solution, or by allowing the solution to fall down a tower up which the carbon dioxide is passing till any sulphide or hydrate formed during solution is converted into carbonate and various impurities are precipitated. The carbon dioxide is usually obtained by burning limestone or by a similar process. The solution is let settle, and is pumped into pans where it is evaporated, more liquor being added to make up for the water which evaporates, until a large proportion of the salt has

separated. It is then raked out of the furnace into drainers, and when drained and cool it is the soda-ash of commerce. Sometimes the carbonating by carbon dioxide is dispensed with, and saw-dust is mixed in with the liquor to carbonize any sulphide or hydrate that may be present. The salt then obtained is black and is known as 'black salt'. When a purer salt is required the soda-ash or black salt is redissolved, allowed to settle, and re-evaporated. It is then known as 'refined alkali'.

**Soda Crystals.**—When soda crystals are to be made, the soda-ash is dissolved in hot water, any insoluble matter being allowed to settle. The solution being kept hot, it is then run into coolers where the crystals separate. The residual mother-liquor is run off, evaporated, and calcined, when it yields a white soda-ash, and the crystals, after draining, are packed for the market.

**Crystal Carbonate** is a very pure monohydrated carbonate,  $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ , made by separating the crystals formed by evaporation at a boiling temperature.

**Bicarbonate of Soda** is made by treating soda crystals with carbon dioxide,  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{CO}_2 = 2\text{NaHCO}_3 + 9\text{H}_2\text{O}$ . The water formed drains off and the bicarbonate is left. This is dried at a moderate temperature, ground, and is ready for market. In a more recent process crystal carbonate is exposed in a revolving cylinder to the action of carbon dioxide.

**Alkali Waste.**—The alkali waste, left when the carbonate is dissolved, contains a large quantity of sulphur as calcium sulphide. It is most objectionable, as on exposure to the air sulphuretted hydrogen is evolved and becomes a nuisance. Many attempts have been made to utilize it and recover the sulphur, but without great success (see *Sodium Thiosulphate* below).

**The Ammonia Process.**—The Leblanc process held undisputed sway in the alkali trade for three-quarters of a century, but it has now been displaced by another process based on quite different principles invented by Ernest Solvay, and patented in 1863. Only the principles of the process can be described. (1) Common salt is dissolved in water so as to form a saturated solution, the brine is purified if necessary from foreign matters by settling or otherwise, and is then run into a closed vessel and is saturated with ammonia. The solution is then passed through a cooler and through filters to remove any suspended matter, and is treated with carbon dioxide, the temperature being kept low. Sodium bicarbonate is formed and precipitated, thus  $\text{NaCl} + \text{NH}_3 + \text{CO}_2 + \text{H}_2\text{O} = \text{NaHCO}_3 + \text{NH}_4\text{Cl}$ . The solution of salt and ammonia is usually allowed to fall down a tower provided with a suitable arrangement of diaphragms to break up the current, whilst the carbon dioxide ascends and is therefore brought into intimate contact with it. The products are sodium bicarbonate and a solution containing ammonium chloride. The bicarbonate of soda is washed, and may be sent into the market as such. To convert it into the normal carbonate it is dried and calcined, the carbon dioxide evolved being used for carbonating more salt, and if soda crystals are required, the anhydrous salt is dissolved and crystallized as usual.

The liquor containing the ammonium chloride is treated with lime, and the evolved ammonia is passed into more solution of salt,  $2\text{NH}_4\text{Cl} + \text{CaH}_2\text{O}_2 = \text{CaCl}_2 + 2\text{H}_2\text{O} + 2\text{NH}_3$ . The apparatus is so arranged that there is the least possible loss of ammonia or carbon dioxide. The carbonate produced by the ammonia process is usually purer than that produced by the Leblanc process. The only resi-

dual product of the ammonia process is the solution of calcium chloride, and many attempts have been made to recover the hydrochloric acid from this with more or less success.

**Sodium Chloride**,  $\text{NaCl}$ , or common salt, is the best known of all the sodium compounds, and is, as a rule, the raw material from which the others are made. It is a white solid, crystallizing in the cubic system. It decrepitates when heated, fuses at a red heat to a clear liquid, and boils at a white heat. It is soluble in water, but insoluble in alcohol, and it absorbs moisture only to a slight extent on exposure to the air. Pure sodium chloride can be prepared by dissolving pure sodium carbonate in hydrochloric acid, or by preparing a saturated solution of the salt in water, and saturating this with hydrochloric acid, when sodium chloride is precipitated. The crystals are filtered off, rinsed with water, and dissolved and crystallized twice from water. At low temperatures definite hydrates are formed,  $\text{NaCl} \cdot 2\text{H}_2\text{O}$  separating at  $-7^\circ$  and  $\text{NaCl} \cdot 10\text{H}_2\text{O}$  at  $-23^\circ$ . Sodium chloride has been known from the remotest antiquity, and is very widely distributed. It occurs in nature as a mineral, and in solution in sea-water. See **SALT (COMMON)**. Sodium chloride is decomposed by sulphuric or other strong acid, hydrochloric acid being evolved; and when the vapour comes in contact with silicates decomposition takes place, a fusible silicate of soda being formed. Salt is therefore used as a glaze for the common varieties of pottery; a little salt being introduced into the kiln, volatilizes, and the vapour coming in contact with the clay is decomposed. See **SALT (COMMON)**. **Sodium Bromide**,  $\text{NaBr}$ , and **Sodium Iodide**,  $\text{NaI}$ , closely resemble the chloride in properties.

**Sodium Sulphate**,  $\text{Na}_2\text{SO}_4$ , is prepared, as already described, by the action of sulphuric acid on common salt, the crude body being called *salt-cake*. It occurs in nature as the mineral thenardite, and in combination with calcium sulphate as Glauberite,  $\text{Na}_2\text{SO}_4 \cdot \text{CaSO}_4$ . It is a white amorphous powder which melts at about  $860^\circ\text{C}$ . and dissolves readily in water with evolution of heat. Heated with charcoal it is reduced to sodium sulphide.

Two hydrates are known. Glauber's salt,  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ , is used to some extent in medicine. It occurs in colourless crystals belonging to the monoclinic system which effloresce in air. It is very soluble in water, the solution producing a considerable fall of temperature. It melts readily, dissolving in its own water of crystallization, and if this solution be allowed to cool, with constant shaking,  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$  separates.

**Sodium Bisulphate** (acid sulphate or bisulphate of soda),  $\text{NaHSO}_4$ , is made by treating sodium sulphate with sulphuric acid. It is obtained as a by-product in the manufacture of sulphuric acid by treating sodium nitrate (soda nitre or Chili saltpetre) with sulphuric acid,  $\text{NaNO}_3 + \text{H}_2\text{SO}_4 = \text{NaHSO}_4 + \text{HNO}_3$ , and in this form is known commercially as 'nitre-cake'. On heating it gives off sulphuric acid, and is therefore useful as a means of applying sulphuric acid at a high temperature. It is soluble in water, and hydrated crystals can be obtained.

**Sodium Sulphite**,  $\text{Na}_2\text{SO}_3$ . This salt is obtained by saturating a solution of sodium carbonate with sulphur dioxide, then adding an equal quantity of sodium carbonate and evaporating to crystallization, when crystals of  $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$  separate. These belong to the monoclinic system. On exposure to the air they effloresce and undergo surface oxidation to sulphate; heated to  $150^\circ$  they lose water and leave the anhydrous salt. The crystals are very soluble in water. The solution has a faintly alkaline reaction,

and oxidizes to sulphate on exposure to the air.

The bisulphite,  $\text{NaHSO}_3$ , is obtained by saturating a solution of sodium carbonate with sulphur dioxide and crystallizing. It is easily soluble in water. On exposure to the air it loses sulphur dioxide. If sulphur dioxide be passed into a solution of sodium carbonate kept at from  $100^\circ$  to  $125^\circ$  C. a sodium meta-bisulphate,  $\text{Na}_2\text{S}_2\text{O}_5$  ( $\text{Na}_2\text{SO}_3\text{SO}_3$ ), is formed. This salt comes into the market in white crystals, and is valuable for many purposes on account of the large quantity of sulphur dioxide which can be obtained from it.

The sulphites are largely used in the arts as reducing agents, as antiseptics, and as sources of sulphur dioxide. They are used as an antichlor for removing the last traces of chlorine from bleached pulp for paper-making and other materials. They are used in photographic developers for preventing oxidation.

**Sodium Thiosulphate** (sodium hyposulphite, hypsulphite of soda),  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ . This salt occurs in large transparent prismatic crystals, belonging to the monoclinic system. It is soluble in water; the solution is neutral to test-paper and does not smell of sulphur dioxide, but decomposes on keeping, forming sulphate and depositing sulphur, and it is decomposed at once by acids, sulphur dioxide being evolved and sulphur separated. It may be prepared by boiling a solution of sodium sulphite with sulphur. Polysulphides of the metals of the alkaline earths—such as the polysulphide of calcium which is present in alkali waste—on exposure to the air absorb oxygen and yield thiosulphate; therefore the salt can be prepared from alkali waste. The waste is exposed to the air and is then lixiviated with water; sodium carbonate is added, which precipitates the calcium as carbonate. After settling, the solution is drawn off, evaporated to crystallization, and the crystals are purified by recrystallization. Sometimes sulphur is added to the tank waste, the whole is boiled with water, and the resulting solution is treated with sulphur dioxide in a closed vessel. The calcium salt is then converted into the sodium salt as before.

Sodium thiosulphate is used in photography as a fixing agent as it dissolves silver chloride, bromide, and iodide readily; and for the same reason it is used in the Von Paterra process of treating silver ores. It is used by the paper-maker as an antichlor, and for many other purposes. It is now made of great purity at a very low price.

**Sodium Nitrate** (soda-nitre, Chili saltpetre),  $\text{NaNO}_3$  is a colourless crystalline salt. The crystals are not cubes, but they are nearly cubic in appearance, whence it is often called *cubic nitre*. It melts at about  $316^\circ$  C. and decomposes at a higher temperature. It is soluble in water, and closely resembles potassium nitrate (nitre) in its general character, and, like it, deflagrates with charcoal. It occurs in considerable quantities in Chili and Peru and other parts of South America.

The crude nitrate is boiled with water in tanks heated by steam, and when strong enough the liquor is run off into crystallizing vats. The crystals are drained, dried in the sun, and exported, and the mother-liquors are treated for the recovery of the iodine which they contain. It is used for most purposes for which nitre is used, as in the manufacture of sulphuric acid; but, being hygroscopic, it cannot be made to replace nitre in the manufacture of gunpowder or fireworks. It is also used for the preparation of potassium nitrate (nitre). For its use as a fertilizer see CHILI SALTPETRE.

**Sodium Phosphate.** Several sodium salts of phosphoric acid are known, but the only one of sufficient

importance to be noticed here is the ordinary phosphate of commerce, hydrogen disodium phosphate,  $\text{Na}_2\text{HPO}_4$ . This crystallizes in large transparent tabular crystals,  $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$ , which effloresce and become opaque in air. The salt is readily soluble in water, and the solution is alkaline to test-paper. It is usually prepared from the acid calcium phosphate produced by the action of sulphuric acid on bone-ash or native phosphates. The hot solution is treated with sodium carbonate until a further addition produces no effervescence, the precipitated calcium carbonate is filtered off, and the solution is concentrated and crystallized.

**Sodium Silicates.** When silica and sodium carbonate, common salt, or other salt of sodium, are fused together, combination takes place and silicates are formed. Sodium silicates are soluble in water, and are known as soluble glass or water glass. The composition of the silicates varies much, according to the proportions in which the constituents have been mixed. The ordinary commercial soluble glass has approximately the composition  $\text{Na}_2\text{O} \cdot 4\text{SiO}_2$ . Sodium silicate is often added to soap to increase its detergent power; it is used in calico printing, for fixing fresco painting, for preserving wood, for rendering wood, &c., unflammable, as a protective agent for stone, in the manufacture of various forms of artificial stone, and, as already mentioned, it forms the glaze on the cheaper varieties of pottery.

**SODALITE**, a name originally given by Thomson to a mineral discovered in West Greenland by Sir Charles Giesecke. It is crystallized in regular dodecahedrons, and also occurs massive; colour green, translucent; hardness about that of felspar; specific gravity, 2.37. It was found by Thomson to consist of silica 38.5, alumina 27.48, lime 2.7, oxide of iron 1, soda 25, hydrochloric acid 3, volatile matter 2. This mineral has since been found in transparent crystals and crystalline masses among the lava of Vesuvius.

**SODIUM.** See SODA.

**SODOM, APPLE OF,** a fruit mentioned by Strabo, Tacitus, and Josephus as growing on the shores of the Dead Sea, which was beautiful to the eye, but when eaten filled the mouth with ashes. It is supposed to have been a gall produced by an insect called the *Cynips insana*. It has furnished a well-known allegory to Milton in his *Paradise Lost*.

**SODOMA.** See RAZZI.

**SODOM AND GOMORRAH**, the principal of the five cities (Sodom, Gomorrah, Admah, Zeboim, and Zoar) which are described in the book of Genesis as the cities of the plain—that is, of the plain of Jordan. They are said to have been overthrown on account of the wickedness of their inhabitants (Gen. xix.), with the exception of Zoar, which was spared at the supplication of Lot. Modern writers are not agreed as to the site of these cities. They have commonly been placed on the south of the Dead Sea, near the Salt Hill of Udsun; but it seems to have been shown conclusively by Sir George Grove (see Smith's Dictionary of the Bible, articles Sodom and Zoar) that this is not in accordance with the Scripture narrative, nor with the other references to these cities in the Bible. Sir George does not profess to fix their site further than that it was to the north of the Dead Sea, and visible on the east from a height between Bethel and Ai. Sodom and Gomorrah are commonly used in the allegorical or denunciatory language of the Scriptures as typical examples of extremely wicked communities.

**SODOR AND MAN, BISHOPRIC OF**, the title of the bishop of the see of Man, who has a seat, but not a vote, in the House of Lords. The origin of the term Sodor in the title is variously explained. The explanation given by Burton, which is that most

generally received, is that the Hebrides or Western Isles were divided into Nordreyer or Norderies and Sudreyer or Suderies, the northern and southern islands. The dividing line was at Ardamurchan. The Suderies or southern division was included in the bishopric of Man.

**SOEST**, a town of Prussia, in the province of Westphalia, 13 miles north of Arnsberg. It is an antiquated place, with dark winding streets, several interesting churches, including a splendid Gothic church begun in 1314, and a R. Catholic cathedral in the Romanesque style; a gymnasium, a normal school, &c. Its industries are concerned with puddling iron, rivets, soap, sugar, hats, cigars, linen, spirits, &c. It stood a memorable siege in the fifteenth century, when the Archbishop of Cologne attacked it at the head of 60,000 men. Pop. (1880), 13,985; (1895), 15,407.

**SOFALA**, a small town on the south-east coast of Africa, on the Mozambique Channel, at the mouth of a river of the same name, belonging to the Portuguese. It is built on an unhealthy marsh, and consists merely of a small assemblage of white-washed mud erections. It has an excellent basin for small vessels, but on account of the shallow bar at its mouth it can be entered only at high-water. It exports some gold-dust, and according to some authors is the Ophir of the ancients.—The same name is given to the district lying on the coast between the mouths of the Zambesi on the north and Delagoa Bay on the south, and extending inland for about 150 miles. It is a low swampy country, densely wooded, and very unhealthy for Europeans. It was discovered by the Portuguese in the end of the fifteenth century.

**SOFIA**, **SOPHIA**, the capital of the principality of Bulgaria, situated in a plain on a small stream, near the foot of the south side of the Balkan Mountains, 310 miles W.N.W. of Constantinople, to which now runs a railway. The older part is indifferently built, consisting for the most part of mean houses and narrow, uneven streets, but has been much improved recently; and on the east a new quarter has risen with handsome private residences, the palace of the prince, the courts of justice, national bank, ministry of war, town-house, theatre, consulates, public garden, &c. Sofia is the see of a Greek archbishop and a R. Catholic bishop; it has a high school or college with three faculties, a national library, &c. There are elegant public baths, very extensive bazaars, and a considerable trade. Sofia stands on the site of the ancient Roman town *Ulpia Serdica*. It was conquered by the Bulgarians in 809, by the Turks in 1382. Pop. (1893), 46,593; (1900), 67,920.

**SOFISM**. See **SUFISM**.

**SOFT-GRASS**. See **HOLCUS**.

**SOIGNIES**, a town of Belgium, in the province of Hainault, 10 miles N.N.E. of Mons. It has regular streets and well-built houses; a church of the twelfth century in the Romanesque style, a townhall in the Spanish style, a college, and numerous schools, an hospital, and an orphan asylum. Pop. 10,000.

**SOILING**, in agriculture, the practice of supporting animals of various kinds in the summer season with green food of different sorts, cut daily, and given to them in racks in the houses, stalls, or yards, instead of sending them to the fields.

**SOILS**, **CHEMICAL CONSTITUENTS OF**. The chemical constituents of soil may be divided into three groups—(1) mineral matter, occurring naturally in the soil; (2) organic matter of the soil; and (3) matter, whether mineral or organic, artificially added in order to increase the value of the soil as a source of nourishment for plants. The mineral matter, which forms by far the largest proportion of most soils, results from the disintegration of rocks by atmo-

spheric and other physical agencies. Phosphoric acid and sulphuric acids, alkalies, lime, magnesia, and iron are the necessary mineral constituents of all soils suitable for the nutrition of plants; the presence of silica, chloride of sodium, and of a few other salts, is required only in the case of certain classes of plants. The organic matter of soil consists for the most part of a peculiar substance called *humus*, which is chiefly a product of the decay of plants grown upon the soil; by the further decomposition of humus ammonia and carbonic acid are formed, both of which are required for plant-life, the former as a source of nitrogen and the latter of carbon. The carbonic acid also exercises a solvent action upon certain of the mineral constituents of the soil, such as earthy phosphates, felspathic minerals, &c. The matter added in the shape of manure is of such a nature as to supply the natural deficiencies of the soil, whether these be mineral or organic. See **HORTICULTURE** and **MANURE**.

**SOISSONS**, a city of France, a fortress of the second rank, in the department of the Aisne, 51 miles north-east of Paris. It is an episcopal see, and contains a fine old cathedral, a college, public library of 30,000 volumes, museum of antiquities, &c. Soissons was the residence of the early Frankish kings, and before the revolution it was the capital of a district called *Soissonnais*. It was anciently called *Augusta Suessionum*, from the Suessiones, to whom it belonged. It was taken by the Germans in 1870 after four days' resistance. Pop. (1896), 9715.

**SOKOTO**. See **SACKATOO**.

**SOLANACEÆ**, or **SOLANÆ** (the nightshade family), a natural order of plants. The characters of the order are—exogenous herbaceous plants or shrubs; leaves alternate, undivided, or lobed, sometimes collateral; floral leaves sometimes double and placed near each other; calyx inferior, 5- or rarely 4-partite, persistent; corolla monopetalous, hypogynous; limb 5- rarely 4-cleft; stamens inserted on the corolla, equal in number and alternate with the segments of the limb; ovary usually two-celled; ovules numerous; fruit with two, four, or many cells; seeds many. This large and valuable order is widely diffused over the world, but is most abundant in the tropics, where, especially in South America, it is most copiously represented by the genera *Solanum* and *Physalis*. It contains sixty-six known genera and about 1200 enumerated species. The order has been divided into two sections—*Rectembryæ*, with the embryo straight, or nearly so; and *Curvembryæ*, with a semi-circular, annular, or spiral curvature of the embryo. These are subdivided into tribes, chiefly distinguished by the nature of the fruit. The plants of this order have three leading properties, the prevalence of one or more of which separately distinguishes different species and genera, each of them predominating singly in certain plants, while in others they are found in various combinations. These properties consist in the possession of matter of a narcotic, stimulant, or starchy and nutritious character; and according as they prevail the plants, or the particular parts of them which they distinguish, are suitable for medicine, condiment, or food. The narcotic is the most prevalent characteristic in the order, and most of the plants in which it is largely developed are deadly poisons. Most prominent of this class is the Deadly Nightshade (*Atropa belladonna*), which contains a poisonous narcotic alkaloid called atropine. (See **NIGHTSHADE**.) The various species of *Hyoscyamus* possess similar properties, which are especially prominent in *Hyoscyamus niger*, henbane (which see). Many species of *Datura* are powerful narcotics. The leaves of the *Datura Stramonium*, (see **STRAMONIUM**) are smoked for asthma. The genus *Nicotiana* is both stimulant and narcotic.

*N. Tabacum* is the species most commonly used for tobacco, but the *N. repanda* is said to be used in Havana for small cigars, the *N. rustica* in Turkey, and the *N. Peruvia* in Shiraz. The oil of tobacco is actively poisonous. It exercises a depressing action on the functions of the heart and brain, to which the well-known soothing qualities of tobacco are due. The *Solanum pseudoquina* of Brazil possesses tonic and febrifuge qualities little inferior to chinchona. The genus *Capsicum* is well known for its pungency; the ground seeds form the favourite condiment Cayenne pepper. The seeds or berries are called in Mexico Chillies, hence the name Chilli vinegar for the solution of them in acetic acid. *Mandragora officinalis* (mandrake) is used as a stimulant of the nervous system. By the Arabs it is called 'the devil's apple.' The *Lycopersicum esculentum* is the edible tomato, the *Solanum tuberosum* the common potato. The leaves and other parts of the potato are powerfully narcotic. The *Solanum laciniatum*, or Kangaroo Apple, is eaten in Tasmania. To the same genus belongs the *Solanum dulcamara*, or Woody Nightshade, a diaphoretic narcotic. The Solanaceae are closely allied to the Scrophulariaceae or FIGWORTS. See SCROPHULARIACEAE.

SOLAN GOOSE, or GANNET (*Sula Bassana*), a well-known species of Gannet, belonging to the section Totipalmate of the Natatorial or Swimming Birds. The Gannet genus (*Sula*) is distinguished by the straight bill, slightly curved at its tip, with its edges unequally serrated or notched; by the wings having their first and second quills longest; by the tail being of graduated conformation; by the tarsi being ridged or keeled posteriorly; by the claw of the middle toe being notched, whilst the nail of the hinder toe is rudimentary; and by the possession of a naked expansile space on the breast. The Solan Geese notably inhabit the Bass Rock in the Frith of Forth, and have other stations or haunts on the northern coasts of Britain. These birds attain an average length of about 3 feet. The head and neck are of a buff colour, the primary feathers of the wings being black, and all the rest of the plumage being white. The young birds are of black colour, streaked with white. The Solan Goose makes great havoc among the shoals of fishes, and is a powerful bird on the wing, as well as an active swimmer. It is frequently caught entangled in the nets of fishermen, and may be taken by a ruse consisting of tying a herring to a piece of floating wood, when the Gannet swoops down to seize the fish, and is stunned or killed by coming in contact with the wood. The nest consists of grass and sea-weed, and is very roughly constructed. Only one egg, of a pale-blue colour, is laid. The Booby (*Sula fusa*) is nearly allied to the Solan Goose, as also is the *Sula variegata*, the excrement of which chiefly furnishes the guano of commerce. (See ORNITHOLOGY, PL. VII., fig. 2.)

SOLANINE ( $C_{27}H_{45}NO_7$ ), a substance which M. Peletier procured from the *Solanum mammosum* of the Antilles. It is also found in the berries of the *S. nigrum*, as well as in the leaves and stems of the *S. dulcamara*. To obtain it ammonia is poured into the filtered juice of the berries, when a grayish matter falls down, which is collected on a filter, washed, and treated with boiling alcohol. The solanine precipitates from this by evaporation. It is an opaque, white, somewhat pearly-looking powder; without smell; very bitter; fusible below  $100^{\circ}C$ ; decomposable at a higher temperature; insoluble in water, ether, oil of olives, and essence of turpentine; but very soluble in hot alcohol, from which it crystallizes in slender, silky needles. It combines with acids, forming salts. It is eminently emetic, and in even small doses poisonous.

SOLAR CORONA, the portion of the aureola, observed during total eclipses of the sun, which lies outside the region of coloured prominences. The region of coloured prominences is called the chromosphere. See SUN.

SOLAR DAY. See SOLAR TIME.

SOLAR MICROSCOPE, an instrument by means of which a magnified image of a small transparent object is projected on a screen, the light employed being sunlight. The solar microscope is really a magic lantern, in which the microscopic object is affixed to a clear plate, and the light employed bright sunlight reflected into the instrument.

SOLAR SYSTEM, the system of which the sun is the ruling centre. The planets taken in order of distance from the sun are Mercury, Venus, Earth, Mars, Asteroids, Jupiter, Saturn, Uranus, and Neptune. Particulars as to their orbits, motions, and systems of satellites are given in the articles under their respective headings.

Astronomy is as yet scarcely more than the science of the solar system; for while we have much yet to learn of the objects comprised in that system, our knowledge of objects beyond it is almost altogether speculative. The first exact information as to the motions of the planets was given in Kepler's laws. Before Kepler's time observations more or less exact had been made, and on the principle that what has occurred with regularity will continue to recur regularly, eclipses were predicted; but the laws which he deduced from Tycho Brahe's observations are the alphabet of astronomy. The laws of Kepler and the science of astronomy were endowed with a living soul when Newton breathed into them his idea of gravitation.

The relative distances of the planets from the sun are accurately known, their relative masses are known, and their orbits, with all their irregularities, are known. As might be expected, the exactness of our knowledge of heavenly bodies depends very much on whether those bodies are distant from the earth. We have most exact knowledge of the motions of the moon, and we can even look on the irregularities of its surface as upon a distant landscape; what we know of Neptune is very inexact compared with our knowledge of the moon, yet it is very considerable compared with what we know about bodies outside the solar system. The belt of asteroids, or planetoids, as they should be called, is made a mark of separation, and planets outside of it are called major planets; planets inside of it are called minor planets. A planet outside the earth's orbit is called a superior planet; a planet which lies inside the earth's orbit is an inferior planet. The mean distance of a planet is half the sum of its greatest and shortest distances from the sun. The eccentricity of a planet is the difference of the longest and shortest distances from the sun divided by their sum.

The wonderful systems of meteors and comets which belong to the solar system, and the sun itself, are continually subjects of observation and speculation, and every year discoveries are made which imply further discovery, and more and more impress us with the complexity of the solar system. With the article ASTRONOMY we give a coloured plate of the solar system.

SOLAR TELESCOPE, an ordinary telescope with an addition invented by Foucault by which heat rays are reflected, and do not enter the instrument. A telescope with a large object-glass will concentrate a great amount of heat at the principal focus when employed to examine the sun's disk; and to remedy this inconvenience the solar telescope is provided with a piece of plate-glass, which is thinly silvered by Liebig's process, placed before the object-

glass. Sunlight transmitted through a thin film of silver is found to have lost nearly all the heat-rays, and the other rays appear to have merely become less intense.

**SOLAR TIME**, time as indicated by a sun-dial. The successive hours indicated by a sun-dial are not equal intervals of time. (See **DIAL**, **EQUATION OF TIME**.) An hour of mean solar time is the average hour, taking the hours in a complete year as indicated by a sun-dial.

**SOLDERS** consist merely of simple or mixed metals, by which ordinarily metallic bodies are firmly united with each other. In this respect it is a general rule that the solder should always be easier of fusion than the metal intended to be soldered by it. Next to this, care must also be taken that the solder be, as far as is possible, of the same colour with the metal that is to be soldered. For the simple solders each of the metals may be used, according to the nature of that which is to be soldered. For fine steel, copper, and brass work, gold and silver may be employed. In the large way, however, iron is soldered with copper, and copper and brass with tin. The most usual solders are the compound, which are distinguished into two principal classes, namely, hard and soft solders. The hard solders are ductile, will bear hammering, and are commonly prepared of the same metal with that which is to be soldered, with the addition of some other, by which a greater degree of fusibility is obtained, though the addition is not always required to be itself easier of fusion. Under this head comes the hard solder for gold, which is prepared from gold and silver, or gold and copper, or gold, silver, and copper. The hard solder for silver is prepared from equal parts of silver and brass, but made easier of fusion by the admixture of one-sixteenth of zinc. The hard solder for brass is obtained from brass mixed with a sixth, or an eighth, or even one-half of zinc, which may also be used for the hard solder of copper. It is sold in the shops in a granulated form, under the name of *spelter solder*. The soft solders melt easily, but are partly brittle, and therefore cannot be hammered. Of this kind are the following mixtures: tin and lead in equal parts; or still easier fusion is that consisting of bismuth, tin, and lead in equal parts; one or two parts of bismuth, of tin and lead each one part. In the operation of soldering the surfaces of the metal intended to be joined must be made very clean, and applied to each other. It is usual to secure them by a ligature of iron wire, or other similar contrivance. The solder is laid upon the joint, together with sal-ammoniac and borax, or common glass, according to the degrees of heat intended. These additions defend the metal from oxidation. Glaziers use resin; and pitch is sometimes employed. Tin-foil, applied between the joints of fine brass work, first moistened with a strong solution of sal-ammoniac, makes an excellent juncture, care being taken to avoid too much heat.

**SOLDIER** (from Latin *solidarius*, from *solidus*, a coin; so French, *soldat*; Italian, *soldato*; Spanish, *soldado*), a person engaged in military service, especially a private as distinguished from an officer. See **ARMY**, **ARMY (STANDING)**, **CONSCRIPTION**, **ENLISTMENT**, **MILITIA**, &c.

**SOLDIER-ANTS**, the name given to certain kinds of ants, forming members of each *termitarium* or colony of White Ants, and of the colonies of the Common or Hymenopterous Ants also. The 'Termite-soldiers' are wingless, and appear to be a specialized form of the 'workers.' Both soldiers and workers are sexless individuals, and among the Termites the difference between them can be observed at the moment of their emerging from the egg. Whilst the workers perform all the tasks incidental

to the life and maintenance of the colony, the duties of the soldier-ants appear to consist in defending the community from the attacks of foes. For this purpose they are armed with powerful mandibles or jaws. Among some species of ordinary Ants the same division of the neuters into workers and soldiers exists. See also **ANTS**, **TERMITES**, &c.

**SOLDIER-BEETLES**, a name sometimes given to certain Beetles or Coleoptera belonging to the family Telephoridae. These beetles are so named from the frequent red coloration of their bodies. They infest Umbelliferous plants, particularly in spring, and appear of carnivorous habits and pugnacious tastes. Both sexes are winged, and the head projects. The last joint but one of the tarsi is bilobular.

**SOLDIER-CRABS**, or **HERMIT-CRABS**, the names applied to several genera of Decapodous Crustaceans, from their combative habits, and from the fact of their inhabiting the cast-off shells of Molluscs, each crab tenanted a single shell like a veritable anchorite. These Crabs belong to the Anomurous section of the order Decapoda. The abdomen or tail is of soft or semi-soft nature, and the limbs or appendages of the abdomen are rudimentary in their nature. To protect this soft abdomen the Hermits seek refuge in the shells of Mollusca. The Common Soldier or Hermit Crab (*Pagurus Bernhardus*) is a familiar denizen of all our coasts, and is most frequently found ensconced within a whelk's shell. This genus has the abdomen turned upon itself, and the abdominal legs form asymmetrical appendages at its tip. The inner antennae are very short. One of the chelae or nipping-claws is greatly developed over the other one, and is used to close the mouth of the shell when the crab retreats into its abode. Another species, *Pagurus Prideauxii*, is noted as invariably having a particular species of Sea-anemone (*Adamsia palliata*) fixed on the exterior of its shell. The Crafty Hermit or Soldier Crab (*Pagurus calidus*) inhabits the Mediterranean Sea. The Diogenes Hermit (*Cenobita Diogenes*) is a large species, found in the West India Islands.

**SOLE** (*Solea vulgaris*), a species of Flat-fishes or Pleuronectidae (which see). The genus *Solea* includes those in which the lower jaw is hidden by the skin, and in which several rows of teeth are developed. As explained in the article Pleuronectidae, the body in the Flat-fishes is merely more flattened from side to side than in ordinary fishes. The Sole is one of the most familiar of our British Flat-fishes. The right side is commonly that which is brown or dark-coloured, and upon which the eyes are situated. The left side is white, and upon this latter side the fish rests. The scales are very small, and are of the placoid variety. The average length, which, however, is frequently exceeded, is about 10 or 12 inches, and the weight about 16 or 18 oz. Yarrell mentions one gigantic specimen which measured 26 inches in length, 11½ in width, and which weighed 9 lbs. The Sole is at its worst from February to the end of March, this being the spawning season. It is eaten during the other months, and the flesh is very palatable and nutritious. These fishes are usually captured by the trawl-net, and sometimes by the line. They inhabit the shallow waters of sandy coasts, and sometimes ascend rivers to spawn. Other species of Soles are the *S. pegusa*, or the Lemon French Sole, so named from its yellow colour; the Variegated Sole (*S. variegata*), which has a reddish-brown colour marked with darker brown bands; and the Solenette or Little Sole (*S. or Monochirus lineatus*), the average length of which is about 5 inches. The Transparent Sole (*Achirus pellucidus*) of the Pacific Ocean, which wants the pectoral fins; and the Zebra

*Sole* (*S. sebrina*) of Japan, are also well-known species.

**SOLEN.** See RAZOR-SHELL.

**SOLENT**, or **SOLENT SEA**, that part of the British Channel separating the north-west shore of the Isle of Wight from the mainland of Hampshire, and extending between the Needles and West Cowes. It has a width varying from 2 miles to 5 miles; and though its navigation is rather intricate, it affords a safe and well-sheltered roadstead to numerous vessels, when either wind-bound or in time of war waiting for convoy.

**SOLESMES**, a town of France, department of the Nord, on the Sella, 20 miles east of Cambrai, with an ancient abbey, and a large and handsome church. Pop. (1896), 5704.

**SOLEURE** (German, *Solothurn*), a canton of Switzerland, bounded on the north by Basel-Landschaft; west, south, and south-east by Bern; and east by Aargau; area, 306 square miles. It is traversed throughout by the Jura, which here assumes the form of seven distinct and nearly parallel terraces, highest in the south, and gradually lowering as they proceed northward from 3000 to 1000 feet. Corresponding with these terraces are a series of parallel valleys. The whole canton belongs to the basin of the Rhine, which receives the far greater part of its drainage through the Aar, which traverses the canton in an E.N.E. direction. The climate is on the whole remarkably temperate. In respect of soil this canton is one of the most highly favoured in Switzerland. Not only in the lower grounds but in many of the mountain-slopes, almost all the ordinary cereals and large quantities of fruit are raised. A large proportion of the surface is occupied by meadows and pastures. On these immense numbers of cattle, both for feeding and dairy purposes, are kept, and the produce forms one of the most important sources of revenue. The woods also are extensive. Manufactures, instead of making progress, appear rather to have recently declined. Limestone is extensively quarried; when susceptible of high polish or variegated it is called Soleure marble. The inhabitants are mostly Roman Catholic, and speak German. Numerous schools are provided, and every child seven years of age must be at school. The government, once aristocratic, was rendered popular by successive modifications from 1831 to 1856. Soleure was admitted to the Confederacy in 1481. It is the tenth canton of the Confederation in order of admission, the sixteenth in extent. Pop. (1900), 100,838, of whom about three-fourths are R. Catholics, the rest Protestants.

**SOLEURE** (German, *Solothurn*; anciently, *Solodurum*), a town of Switzerland, capital of the above canton, finely situated on the south side of one of the most beautiful parts of the Jura chain, on both sides of the Aar, here crossed by two bridges, 18 miles north of Berne. It is well built; has wide, well-paved streets, several good squares, of which that of the market place, adorned with a fine fountain, is the best. The principal edifices are the minster or cathedral, the clock tower, of Burgundian origin, a massive square of solid masonry, rising for 80 feet without window or other opening; the townhouse, an old irregular building, surmounted by several towers; the museum, containing a rich collection of Jura fossils; the barracks, the arsenal, with a very curious and extensive collection of ancient armour; the theatre, public library, and gymnasium. The manufactures are of little consequence, and consist chiefly of cotton stuffs, leather, iron-ware, paper, beer, and vinegar. Trade also is very limited. Pop. (1901), 10,116.

**SOLFAING** signifies to exercise the voice upon the syllables *do, re, mi, fa, sol, la, si* (solmization), used to designate the notes of the diatonic scale.

Pieces without text, intended for this sort of exercise, are called *sofeggi*. Sometimes this word is applied also to instrumental music (for example, on the piano), and then those pieces are meant which are merely intended to exercise the learner in reading notes and hitting intervals. See TONIC SOL-FA SYSTEM.

**SOLFATARA**, the Italian name for a kind of volcanoes found in various parts of the earth, which, though not in a state of actual eruption, give out sulphureous gases and vapours.

**SOLFEGGI.** See SOLFAING.

**SOLFERINO**, a village and commune of Italy, in the province and 18 miles north-west of Mantua; with a church and two chapels. In 1796 the Austrians were here defeated by the French prior to the siege of Mantua; it was here also, on 24th June, 1859, that a battle was fought between the French and Sardinians on the one side and the Austrians on the other, resulting in the defeat of the latter, and the subsequent treaty of Villafranca. Pop. 1160.

**SOLICITOR**, in England, an officer of the Supreme Court of Judicature who is entitled to sue out any writ or process, or commence, carry on, solicit, or defend any action or other proceeding in any court whatever. Solicitor of the Supreme Court is the title given by the Judicature Act, 1873, to all attorneys, solicitors, and proctors. Before that act attorneys conducted business in the common law courts, solicitors conducted business in the Court of Chancery, and proctors conducted actions in the ecclesiastical and admiralty courts. The solicitor-general is a law officer of the crown next in rank to the attorney-general, and who in the absence of the attorney-general may exercise his functions. The Solicitor-general of Scotland is a law officer bearing a relation to the lord-advocate similar to that which the Solicitor-general of England bears to the attorney-general.

**SOLID**, a solid in geometry is a magnitude having three dimensions—length, breadth, and thickness. A solid in physics is a body characterized by invariability of form; so much so, that the motion of one of its parts produces motion in the whole.

**SOLIDIFICATION**, the passage of a body into the solid state. A body, on solidifying from the liquid state, gives up a quantity of heat without exhibiting a decrease of temperature. For example, suppose we take 1 lb. of water at 0° C., and pour into it 10 lbs. of mercury at -30.3° C.; the mercury will rise in temperature to 0° C., the water will not fall in temperature, and nearly  $\frac{1}{4}$  lb. of ice at 0° C. will be formed. Ten units of heat, required to raise 10 lbs. of mercury from -30.3° C. to 0° C., have been supplied by  $\frac{1}{4}$  lb. of water in solidifying; it would thus take nearly 70 lbs. (accurately 69 lbs.) of mercury at -30.3° C. to freeze 1 lb. of water.

Two laws are recognized in the solidifying of bodies from a state of fusion:—

(1.) *A substance begins to solidify at a temperature which is fixed if the pressure is fixed; at ordinary atmospheric pressure this temperature is the temperature or point of fusion for the particular substance.*

(2.) *From solidification commences till it is completed the temperature of the liquid portion is constant.*

There are some substances, such as glass and iron, which become plastic before liquefying, and therefore possess no definite point of fusion; and for such substances the above laws do not hold. It is possible that these substances really give the rule, and that all bodies, in fusing or solidifying, pass through a stage of plasticity; but in the majority of cases the rise or fall of temperature on passing through the plastic condition is so small that it is not detected. Solidification is called *crystallization* when crystals which may be seen are formed. Such bodies as organic

tissues, glass, glue, and lampblack are said to be non-crystallized; yet it is extremely probable that all solid bodies would be found to be assemblages of crystals if we possessed optical instruments by which we could see the minute structure of substances.

Bodies may solidify by cooling from a state of fusion, or they may crystallize or be precipitated from solution; there is, however, no difference between the quantity of heat given up by a body solidifying from a solution and that given up by the body solidifying from a state of fusion, if the solids resulting in the two cases are identical.

When water solidifies the resulting ice is about  $\frac{1}{11}$  larger than the volume of water which produced it, and on this account ice floats on the surface of water. Cast-iron is larger, at the temperature of the fusing-point, in the solid state than in the liquid state; so also is bronze and other metals which give good sharp castings. In many cases a substance contracts in the act of solidifying; and since the general effect of heat on bodies is to expand them, contraction in the act of solidifying might be considered most natural, because we have seen that heat is abstracted from a body to solidify it. Lead is an example of a body which contracts continuously on cooling from the liquid state. Dr. James Thomson has shown that with bodies which expand in the act of solidifying increase of pressure lowers the temperature of solidification, while with bodies which contract continuously pressure raises the point of solidification.

Some cases of solidification in the popular meaning of the term may be considered. A mass of lime-putty, in drying, is split up by numerous cracks due to shrinkage; if the putty be mixed with sand shrinkage acts more uniformly through the mass, the cracks are not so large and continuous, and the dried mass holds better together, though small pieces are not so firm as in the case of pure putty. Pressure will compel the solid particles of a mud to approach one another as water is removed from it, whether by evaporation or drainage; and in this way we account for hard slate occurring where clayey sediment has sustained great pressure. In the solidifying of a mixture of plaster of Paris and water the water does not leave the compound, but actually solidifies in the crystals of gypsum which are formed, and the substance may be brought to the floury condition again by submitting it to heat sufficient to expel the water of crystallization. In the case of Portland cement water combines chemically with the lime and clay of which Portland cement is composed. With plaster of Paris and Portland cement there is very little shrinkage.

**SOLIDUNGULA** ('Single-hoofed'), a division of the Mammalian order Ungulata (which see) or Hoofed Quadrupeds, represented by the Horses, Asses, Zebras, &c. This group, in former arrangements of the Mammalia, usually ranked as a distinct order, but it has now been incorporated with the Ungulate Quadrupeds as a characteristic subdivision of that order. The Solidungula are distinguished primarily by the fact that the feet have each a single well-developed toe only, this toe—the third—being encased in a broad 'hoof' or nail, and forming the sole support of each limb. No supplementary hoofs exist, although rudimentary toes may exist concealed beneath the skin. The teeth form an interrupted or discontinuous series in each jaw, the males possessing canine teeth, which are absent in the female animals. The incisors number six, the canines two, the premolars six, and the molars six in each jaw. The skin is hairy, and a 'mane' exists on the neck.

**SOLIDUS**, a Roman coin originally called aureus. See **AUREUS**.

**SOLIMAN II.** See **SOLYMAN II.**

**SOLINGEN**, a town of Prussia, in the Rhine province, with manufactures of iron and steel ware, especially swords, for which it has long been famous; copper and brass ware, cutlery, and surgical instruments are among the manufactures, also linen, cotton, and silk fabrics. Pop. (1900), 45,249.

**SOLIS**, ANTONIO DE, a Spanish poet and historian, born at Placenza, in Old Castile, in 1610. His inclination for dramatic poetry procured him the acquaintance of Calderon, for some of whose pieces he wrote the preludes (*loas*). He is principally known at present as a historical writer. Having been appointed historiographer of the Indies, he drew up a work entitled *Historia de la Conquista de Mejico*, which passed through many editions, and of which an English translation was published in 1724 (folio). He took orders in the church in the latter part of his life, and died at an advanced age in 1686. An edition of the *History of the Conquest of Mexico*, in the original Spanish, was printed in London in 1809 (three vols. 8vo).

**SOLITAIRE** (*Pezophaps*), a 'wingless' bird, which has become extinct within comparatively recent times. It inhabited the Islands of Bourbon and Rodriguez within the last 300 years, and was in all probability exterminated by the hand of man. The wings were present in a very rudimentary condition, and were certainly too short for purposes of flight. The remarkable bird named the Dodo, which inhabited the Island of Mauritius, and was abundant in 1598, but has since then become completely exterminated, probably resembled the Solitaire; but the latter was of less size than the Dodo. Probably the Solitaire was a Rasorial or Gallinaceous bird, allied to the Pigeons or Columbidae. It was described by Leguat, a French voyager, under the name of the 'Solitary,' and this traveller tells us that the feathers of the males were of a 'brown-gray colour,' the feet and beak being like a turkey's, but 'more crooked.' He notes that the tail was inconspicuous in size, the hinder parts being rounded; the neck was straight, and the eye black and lively. 'They never fly,' says Leguat; 'their wings are too little to support the weight of their bodies; they serve only to beat themselves, and to flutter when they call one another.' Some of the males were said to weigh 45 lbs. The plumage of the females is described by Leguat as of lighter colour than that of the males.

**SOLMIZATION.** See **SOLFING**.

**SOLO** is a piece of music, or a passage in which a single voice or instrument performs quite alone (that is, without accompaniment), or is distinguished above the other voices. Thus there are violin solos, solos for the pianoforte, &c., pieces for the violin or the piano only; but a solo for the violin also signifies a passage in which the violin part is the principal. A solo also, in a piece of music for several instruments or voices, denotes a passage which is to be executed by one of the instruments separately. And *tutti* signifies that all the voices or instruments are to commence again after the solo has been played. *Sol*, in the plural, denotes that two or more voices or instruments are to execute a passage in the same manner, distinctly from the other instruments or voices. (See **OBLIGATO**.) Peculiar freedom, ease, distinctness, and power of execution are required to perform the solo with correctness, taste, and feeling.

**SOLOMON** (Hebrew, *Shelômôh*, the Prince of Peace), son of David, king of Israel, by Bathsheba, formerly the wife of Uriah. He was appointed by David to be his successor on the throne in preference to his elder brothers. On his accession he caused his brother Adonijah, and Joab, the late commander of the army, who had entered into a conspiracy against him, to be put to death, and confirmed his

power by forming alliances with foreign rulers. His remarkable judicial decisions, and his completion of the political institutions of David, showed a superiority of genius which gained him the respect of the people. By the building of the temple, which, in magnitude, splendour, and beauty, exceeded any former work of architecture, he gave to the Hebrew worship a magnificence which bound the people more closely to their national rites. The wealth of Solomon, accumulated by a prudent use of the treasures inherited from his father; by successful commerce, through which he first made the Hebrews acquainted with navigation; by a careful administration of the royal revenues, which he caused to be collected by twelve governors; and by an increase of taxes,—enabled him to meet the expense of erecting the temple, building palaces, cities, and fortifications, and of supporting the extravagance of a luxurious court. But while, on the one hand, the prosperity of the people was promoted, and the arts and civilization were improved; on the other, an example of pernicious luxury, and of a gradual relaxation of the severity of the Mosaic religion, was exhibited. Admiration of Solomon's wisdom and regal magnificence, which brought crowds of foreigners to his capital, and among the rest a queen of Sheba, easily drowned the few voices of discontent. His administration of justice gained him the respect of his subjects; and an army stood at his command, consisting of 12,000 horsemen, armed in the Egyptian manner, and 1400 war-chariots, to overawe the Gentile tribes, which had been subjugated by David to the Jewish yoke, and were now forced to labour in the service of Solomon. Fortune long seemed to favour this great king; and Israel, in the fulness of its prosperity, scarcely perceived that he was continually becoming more despotic. Contrary to the laws of Moses, Solomon admitted foreign women into his numerous harem of 700 wives and 300 concubines; and from love to these women he was weak enough in his old age to permit them the free practice of their idolatrous worship, and even to take part in it himself. Still his adversaries, who, towards the close of his life, aimed at his throne, could effect nothing; but after his death the discontent of the people broke out into open rebellion, and his feeble son Rehoboam could not prevent the division of the kingdom. The forty years' reign of Solomon, the last years of which were less glorious than the first, is still, however, celebrated among the Jews for its splendour and its happy tranquillity as one of the brightest periods of their history. Throughout the East it is considered as a golden age. The wisdom of Solomon is spoken of in the Bible as a divine gift, and he is represented as pre-eminent in this respect over all other men. In 1 Kings, chap. iii. 5-14, there is an account of a vision, in which, in answer to a petition for wisdom, Solomon is promised wealth and wisdom, both exceeding that of any of his predecessors or successors on the throne. The writings attributed to Solomon among the canonical books of the Bible are the book of Proverbs, Ecclesiastes, and the Song of Solomon. With the exception of some of the Proverbs, the authenticity of all is disputed. Separate notices are given of each of them. The apocryphal book, the Wisdom of Solomon, also professes to be his composition. For the chronology of Solomon's reign see Jaws. Solomon's wisdom and happiness have become proverbial; and the fables of the rabbins, and the heroic and erotic poems of the Persians and Arabians speak of him as the romantic traditions of the Normans and Britons do of King Arthur, as a fabulous monarch, whose natural science, whose wise sayings and dark riddles, whose power and magnificence, are attributed to magic. Accord-

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ing to these fictions Solomon's ring was the talisman of his wisdom and power, and, like the temple of Solomon in the mysteries of the Freemasons and Rosicrucians, has a deep symbolical meaning.

**SOLOMON'S SEAL** (*Polygonatum*), a genus of plants belonging to the natural order Liliaceae. The rhizomes of *P. officinale* and *P. multiflorum* are sold in the herb-shops under the name of Solomon's Seal, and are employed as a popular application to remove the discoloration of bruised parts of the body, and especially the eyes. The genus was named by Linnaeus *Conrallaria*. The perianth is shortly six-cleft at the summit; stamens six, inserted upon the middle of the tube of the perianth; ovary three-celled; berry three-celled. In the officinal species the leaves are ovate-elliptical, alternately half embracing the angular stem; peduncles mostly single-flowered; flowers fragrant. *Conrallaria majalis*, closely allied to the plants of this genus, is the well-known lily of the valley.

**SOLOMON'S SONG** (called also the **SONG OF SONGS**, or **CANTICLES**), one of the canonical books of the Old Testament. From the earliest period this book has been the subject of voluminous controversies, into the history of which we have not space to enter. The canonicity of the book has rarely been disputed, except on internal grounds. It seems to be proved that it was a recognized part of the Jewish canon in the time of our Lord. On the other hand, those who object to its canonicity urge that it is not quoted or alluded to in the New Testament. Till the beginning of the nineteenth century the author of the book was almost universally believed to be Solomon, as seems to be implied in the inscription. Many modern critics, however, on the ground of alleged Chaldeeisms in the text, ascribe it to a period as late as Ezra. As to the form of the poem, it has been disputed whether it is a single song or a collection (as implied in the Targum title), and whether, if one, it is dramatic, idyllic, or pastoral. The unity of the poem is sufficiently evidenced by the continuity of names, characters, and subject, and is taken for granted by the majority of critics. The poem is partially dramatic in form, but it has not been proved that it is a regular drama, or that it can be reduced to any other of the artificial models contended for. The main subject of dispute is as to the interpretation of the poem. The various theories of interpretation are too numerous to specify; but all are divided into two classes, the literal and allegorical. The highest form of allegorical significance contended for is the mystical or spiritual interpretation, by which the whole poem is transformed into a figurative representation of the hopes and aspirations, together with the trials and difficulties, of a spiritual life. The allegorical or mystical interpretation, whether applied individually or collectively to the church or nation of Israel, was almost universally received both by Jews and Christians until recent times. Only a few isolated objectors can be found before the epoch of modern criticism.

The most favoured literal interpretation is that originally given by Jacobi, and variously developed by other critics, that the poem represents the temptation and triumph of virtuous love. The tempter is Solomon, the object of his solicitation a Shunamite shepherdess, and the third of the *dramatis personae* her shepherd lover. Some of the holders of this view do not hesitate to affirm it as a sufficient subject for an inspired poem, and adequate to justify its place in the canon of Scripture. Others, more consistently, refuse to assign to it any sacred character.

The supporters of the allegorical interpretation of the book strongly urge the frequency with which the marriage relation is employed, both in the Old and

New Testament, to represent the relation of Jehovah to Israel in the old, and of Christ to the church in the new dispensation. The 45th Psalm, the prophecies of Jeremiah and Ezekiel, the parables of our Lord, the epistles of St. Paul, and the Apocalypse, are adduced as proof. To this it is replied that there is no instance of this metaphor so early as the alleged date of the Song of Solomon; that the applications of the metaphor in this book would be blasphemous; and that it contains no mention of the name of Jehovah.

The first objection, it is replied, has not much weight; the second is a prejudging of the question, which is one of inspiration. A charge of blasphemy against the use of a metaphor is a very unsafe criterion on such a subject, and the same charge, it is also observed, has been brought against Scripture as a whole, and especially against the teaching of our Lord. In reply to the third objection, it is held that any direct explanation of the metaphor is unnecessary, and would be in bad taste, the main design being evident from the whole tenor of the composition, its unusual elevation of tone and sentiment, as well as from the habitual tendency of oriental writers to the use of metaphor. No other subject, it is urged, would be worthy of its place in the canon, and its reception there, as well as its title, the Song of Songs, whether the author's or not, proves how readily the import of the metaphor was apprehended, as the name song being given to other sacred compositions in the record, the superlative designation would never have been conferred on one which had an inferior subject. The inapplicability of a literal interpretation, and the unsatisfactory nature of those which have been proposed, are also strongly urged. Passages are pointed out, of which nothing can be made in a literal interpretation, as chap. viii. 8-11. In particular it is observed that many passages, as chap. v. 7, describe situations which can only be intended in a metaphorical sense, as the use of such metaphors is common with oriental poets, while their literal interpretation would be a violation of the proprieties of oriental life, and would be simply ruinous to the character of an individual heroine, a risk which no judicious poet would run. The holders of an allegorical interpretation generally assume some literal basis for the poem, but it is the common view that the poet, warmed by the vision which rises to his imagination of a higher theme, soon loses sight of his original figure, and, attaching himself to the principal theme, allegorizes upon it with a freedom which casts aside the trammels of a literal interpretation. The principal personages in the poem, Shelômôh and Shulamith, are otherwise held to be from the first typical characters, in support of which it is urged that the plural form is frequently used, even in the same passages with the singular, in describing the actions and sentiments of the latter, as chap. i. 4: 'Draw me, we will run after thee, . . . we will remember thy love more than wine: the upright love thee.'

A very ingenious theory is propounded by Dr. Weir in the Imperial Bible-Dictionary. (See article Canticles.) He holds that the foreign element in the language of the Song is not Chaldee, but Syriac and Arabic; that the local references, except where Jerusalem is introduced as the centre of divine worship, are chiefly to the northern and eastern divisions of Canaan, Carmel, Sharon, Gilead, and Damascus. This he regards as indicating that the author was one whose habitual residence was not in Jerusalem, but in the north of the kingdom. These circumstances are not always held inconsistent with the authorship of Solomon, who, it is said, might compose the poem while residing at Lebanon for the pleasures

of the chase, and imitate the language of the northern inhabitants; but Dr. Weir suggests that the poem was written after the separation of the kingdoms, and indicates the longing of the patriotic Israelites for the temple worship and the glories of the reign of Solomon. This theory, if accepted, might throw some light on the absence of direct mention of Jehovah or explicit allusions to his worship.

SOLON, one of the seven wise men of Greece, and the legislator of Athens, flourished about B.C. 600 (being born probably B.C. 688). He was descended from the ancient kings of Athens, and in particular from Codrus, but was in such narrow circumstances as to be obliged to get his living by commerce. He possessed poetical talents, and had acquired extensive knowledge by his travels. It was by his advice that the inhabitants of Cirrha were punished for a violation of the temple at Delphi; that those persons who had, contrary to their promise, murdered the adherents of Cylon (who attempted to make himself master of Athens) on sacred ground, were arraigned and condemned; and that Epimenides was sent from Crete to purify the city and to soften the fierceness of the Athenians by religious influences. Plutarch, who is the best authority on the life of Solon, says that he made use of the services of Epimenides in the promulgation of his laws. One of the earliest public transactions of Solon had reference to the recovery of Salamis. The island had been conquered by the Megarensians, and all the attempts of the Athenians to reduce it had been without success. It had therefore been forbidden, under pain of death, to propose the renewal of the attempt. Solon, discontented with this state of things, composed an elegy reproaching the Athenians for their weakness, and, feigning himself mad, recited the poem with the greatest warmth before the people. The impression which he produced was heightened by the exhortations of Pisistratus, who mingled with the crowd; a new war was resolved upon, and the command of the expedition was given to Solon and Pisistratus. By the courage and prudence of the commanders, Salamis was recovered. Athens being reduced to great perplexity by the division of parties and the distress of the poorer citizens, who were overwhelmed with debt, in the third year of the forty-sixth olympiad (B.C. 594) all parties united in choosing Solon archon, and in investing him with unlimited powers. He raised the nominal value of money (this is disputed by Grote); entirely abrogated the debts, or reduced them so that they should not be burdensome to the debtors; and abolished the law which gave a creditor power to reduce his debtor to slavery. The success of his measures further induced the citizens to intrust him with the task of entirely remodelling the constitution. (See ATTICA.) When Solon had completed his laws he bound the Athenians by an oath not to make any changes in his code for ten years. He himself left the country, to avoid being obliged to make any alterations in them, and visited Egypt, Cyprus, and other places. The story told by Herodotus of his visit to Croesus (see CROESUS) at this time is inconsistent with chronology. Returning to Athens after an absence of ten years, he found the state torn by the old party hate; but he was received with general esteem, and all parties submitted their demands to his decision. Among the leaders at this time was Pisistratus, who was at the head of the popular party. Although a friend and favourite of Solon, he found an opponent in him when his purpose of obtaining the sovereignty became obvious. Solon left Athens for ever, and died soon after; but when and where his death took place is uncertain. He is generally represented to have died in his eightieth year, in the second year of the fifty-

fifth olympiad. The extant fragments of his poems are collected in Bergk's *Poetae Lyrici Graeci* (vol. ii, 4th ed., 1882). The letters to Pisistratus and to some of the seven wise men, attributed to him, are spurious. Solon's position and importance in Greek history are discussed in various recent works.

**SOLOR**, an island in the Indian Archipelago, at the southern entrance to the Strait of Flores; lat.  $8^{\circ} 47' S$ ; lon.  $123^{\circ} 8' E$ ; 30 miles long by 15 miles broad. It is hilly, partly stony, and little cultivated. The people consist of the mountaineers or aborigines, and the maritime inhabitants, who are Malays. The chief exports are wax and fish-oil, which last is procured from a species of black whale.

**SOLOTHURN**. See **SOLEURE**.

**SOLSTICES**, the points where the sun reaches its greatest distance from the celestial equator. At the summer solstice the sun is at its greatest distance north of the equator; at the winter solstice the sun is at its greatest distance south of the equator. The period of the summer solstice (21st June) is said to be midsummer, and that of the winter solstice (22d December) midwinter; these dates are popularly so named. In our article **SEASONS** we follow the best authorities in defining summer and winter as commencing at the respective solstices.

**SOLUTION**. See **COHESION**.

**SOLWAY FIRTH**, an arm of the Irish Sea, forming part of the boundary between England and Scotland, and extending inland in a north-eastern direction for above 41 miles, with a breadth diminishing from 20 miles, at its entrance between St. Bees Head in Cumberland, and Rayberry Head in Kirkcudbrightshire, to 7 miles, and finally only to 2 miles. On the Scottish side it receives the Urr, Nith, and Annan; and on the English side, the Derwent, Ellen, Waver, Wanspool, and Eden. All these rivers, owing to the rapidity with which the tide advances, are liable to a bore at high springs. A large portion of the Solway is left dry at ebb-tide, and the water, from the quantity of sand, is of a whitish colour. It abounds with fish, and has several valuable salmon-fisheries. On the English coast are Whitehaven, Workington, Maryport, Allouby, Silloth, and Port Carlisle, and on the Scottish Annan and Kirkcudbright.

**SOLWAY MOSS**, a tract of land in Cumberland covered by a loose liquid moss, composed of mud and putrid fibres of heath diluted by internal springs, which in 1771 burst and overflowed about 500 acres of fertile land. These were afterwards cleared by washing the superincumbent moss into the Esk.

**SOLYMAN**, or **SULEIMAN I.** (called the *Lawgiver* by his own subjects, and the *Magnificent* by the Christians), was the only son of Selim I., whom he succeeded in 1520. Three days previous to the death of his father, and at the same time when Charles V. was crowned at Aix-la-Chapelle, he was proclaimed sultan. He had not been educated in the usual manner of the Ottoman princes; but, on the contrary, had been initiated in all the secrets of state policy. His love of justice appeared at the very commencement of his reign, when he returned the property which his father had taken from individuals. He restored the authority of the courts of justice, which had been entirely destroyed, and selected governors and other officers from persons who possessed property and were honest. 'I intend,' said he, 'that they should resemble the rivers which fertilize the countries through which they flow, not the streams which break down all they meet.' Gazeli Beg, the governor of Syria, had at first declared against Solyman, and involved a part of Egypt in his revolt; but he was overcome by the generals of Solyman, who also destroyed the Mamelukes in

Egypt, and concluded an armistice with Persia. Having thus secured himself from disturbance on the side of Syria and Egypt, he besieged and took Belgrade in 1521. In 1522 he resolved to besiege the island of Rhodes, which had been in the possession of the knights of St. John for 212 years. He wrote a haughty letter to the knights, in which he called on them to surrender, unless they wished to be put to the sword. The siege of Rhodes cost him many men; but at length the town, being reduced to extremity, was forced to surrender, December 26, 1522. The conqueror now turned his arms against Hungary, where he gained the battle of Mohacs in 1526, and captured Buda. He took Buda a second time in 1529, advanced to Vienna, and in twenty days made as many assaults upon this city, but was finally forced to raise the siege, with the loss of 80,000 men. In 1534 he marched towards the East, took possession of Tauria, but was defeated by Shah-Thomas; and in 1565, after numerous campaigns in Europe with varied success, his army met with the same fate before Malta as formerly before Vienna. In 1566 he took possession of the island of Scio, and in September of the same year ended his life at the siege of Szeged, in Hungary, in the seventy-sixth year of his age, and four days before the taking of the fortress by the Turks.

**SOMATIC LIFE**, the name applied to the inherent vitality of the tissues and organs of the body, as distinguished from the more active sense in which the word 'life' is applied to that of the organism as a whole. Thus after the death of an organism the somatic life or vitality of the tissues may exist for some time, as is well seen in the contraction of muscle shortly after death on a stimulus being applied to it. The name molecular life might reasonably enough be applied to indicate the inherent vitality of the tissues, which may and generally does persist after the organism is said to be 'dead' in a popular sense. The *duration* of this somatic life varies very much in different tissues, individuals, and according to the concomitant circumstances of the case. The tissues of the cold-blooded animal will thus exhibit a longer duration of inherent vitality than those of the warm-blooded form. Thus muscular movements may be excited by stimuli in the bodies of turtles which have been decapitated some weeks previously. The consideration of this subject opens up a view of the living organism as interesting as it is instructive to reflect upon. The tissues thus possess, in their intimate or component cell-elements, a certain life of their own, which may be said in a manner to be independent of that of the organism as a whole. And in active life, as after death, we find a strict ratio between the degree of vitality possessed by different tissues. The more highly and actively functional a tissue is (for example, the muscular and nervous tissues), the more speedily will its somatic life depart, whilst less highly-organized parts may preserve their vitality for considerable periods.

**SOMAULI-LAND**, a country on the eastern coast of Africa. It is of a peninsular form, bounded on the north by the Gulf of Aden; on the east by the Indian Ocean, from Cape Guardafui to the equator. Its other boundaries are indefinite. The interior of this tract of land is very imperfectly known, but considerable portions of it appear to be little better than deserts, and, as a whole, it seems to be a tableland broken here and there by ranges of mountains. A valley called the Wadi Nogal, or 'Happy Valley,' is spoken of in the most glowing terms. It is extremely fertile and beautiful, and abounds in game and water. The greater part of the northern coast, and a portion of the eastern, south of Cape Guardafui, is lined with hills of considerable elevation, in

some parts attaining a height of between 6000 feet and 7000 feet. On some of the mountain-ranges many large blocks of pure white marble are found, with abundance of obsidian, gypsum, and large masses of basalt. It is not a little remarkable that the majority of the streams flowing from the mountains on the coast are bitter, and in quality highly astringent. There are, however, others that afford most delicious and pure water. Several varieties of gum-trees occur, and the mimosa, tamarisk, wild fig, and several species of the cactus and aloe are abundant. Wild beasts are numerous; they include elephants, lions, leopards, hyenas, wolves, and jackals. Several varieties of deer, jerboas, squirrels, and a species of toucan are common. White vultures of enormous size are frequently seen; also the common osprey. The Somaalis are represented as perfidious, bigoted, and quarrelsome. The principal articles of trade or produce are myrrh, ivory, ostrich-feathers, and gum-arabic. Berbera and part of the northern coast now belong to Britain, while Italy claims great part of the east coast.

**SOMBRERETE**, a small town of Mexico, about 80 miles north-west of Zacatecas, and in the province of that name; remarkable only for the rich mines of silver in its neighbourhood.

**SOMERSET**, a county of England, bounded north by the Bristol Channel and by Gloucestershire, east by Wiltshire and Dorsetshire, south by Dorsetshire and Devonshire, west by Devonshire and the Bristol Channel; area, 1,039,711 acres. The coast is, in the east, with the occasional interruption of a few limestone cliffs, low and marshy; but in the west is generally lined with lofty cliffs composed of slate. A considerable part of the interior consists of ranges of hills; in some districts there are extensive low marshy flats or fens. In the north-east these hills are irregularly grouped, and form a number of picturesque eminences, the loftiest of which, Lansdown and Dundry Hills, attain the respective heights of 813 feet and 768 feet. East of these groups, and extending in a W.N.W. direction from near Frome to the Bristol Channel, are the Mendip Hills, which form a marked and continuous range nearly 30 miles long, and in some parts exceed 1000 feet in height. The Quantock Hills, occupying the west part of the county, are still more elevated, and in their culminating point, called Bagborough Station, or Will's Neck, attain the height of 1262 feet. In the north-east the prevailing strata belong to the oolite formation, and contain the quarries which furnish the famous Bath stone; in the east and south-east magnesian limestone is largely developed; on the north-east side of the Mendip Hills, extending from the neighbourhood of Frome towards Keynsham, are three small isolated coal-fields, forming the southernmost deposit of that mineral in England. These fields are skirted, particularly on the south, by mountain limestone, interrupted by occasional patches of old red sandstone. In the west of the county the latter forms the prevailing formation, and consists chiefly of slaty rocks, forming the wild moorlands of Exmoor Forest. Over 983,000 tons of coal were raised in 1899. Besides the Avon and Parret, the former bounding the county on the north-east, and the other traversing it nearly centrally in a north-west direction, numerous other streams descend from the hills, and afterwards wind circuitously among the marshes. Among others are the Yeo, Axe, Brue, another Yeo or Ivel, and the Tone. The railways belong chiefly to the Great Western system, the main line, after skirting the county from Bath to Bristol, pursuing a somewhat circuitous course south to Taunton, and joined on its way by several important branches. Both the soil and climate of

Somersetshire are well adapted for agriculture, and particularly on the rich alluvial tracts and in the vale of Taunton, heavy crops of the finest wheat are raised. The meadows and pastures are remarkably luxuriant, and rear large numbers of excellent cattle. The hilly grounds are pastured with Leicester, cross-breeds, and Southdown sheep. The area under corn crops, chiefly wheat, oats, and barley, is about 96,000 acres, and that under green crops, mainly turnips and mangold, is about half as much. There are about 650,000 acres of permanent pasture and 50,000 acres of mountain and heath used for grazing. Woods and plantations cover about 46,000 acres. The manufactures, mostly woollen and worsted goods, gloves, silk, linen, crape, glass, bath-bricks, and lace, have their principal seats at Frome, Taunton, Wellington, Chard, Crewkerne, Bridgewater, and Shepton-Mallet. Cheddar and other cheese and much cider are made. Salmon, herring, and other fisheries are carried on to some extent in the Bristol Channel. The county is nearly co-extensive with the diocese of Bath and Wells. For administrative purposes it is divided into forty hundreds, two liberties, the cities of Bath and Wells, part of the city of Bristol, and the municipal boroughs of Bridgewater, Chard, Glastonbury, Taunton, and Yeovil. Since 1885 the county has had seven divisions, each of which sends one member to Parliament. Taunton sends one member, and Bristol four. Pop. (1891), 484,337; (1901), 508,104.

**SOMERSET**, DUKE OF. See SETMOUR.

**SOMERSET HOUSE**, Strand, London, stands on the site of a palace commenced in 1547 by the Protector Somerset, but left unfinished at his death in 1552. After being the residence of several royal personages the building was taken down to make room for the erection of various government and semi-public offices, and the present building was begun in 1776 from designs by Sir William Chambers. It is in the Italian style with capitals of various Grecian orders. The east front, forming King's College, was added by Sir R. Smirke, and the west wing, facing Lancaster Place, by Pennethorne. The Strand front is 155 feet long, and its centre is pierced by three arcades leading into a quadrangle 319 feet by 224. The river front is 800 feet in length, and is much finer than that facing the Strand. Somerset House contains the offices of the Registrar-General of births, deaths, and marriages, the exchequer and audit departments, the inland revenue and the probate and divorce registries of the High Court of Justice.

**SOMERS ISLANDS**. See BERMUDAS ISLANDS.

**SOMERVILLE**, MARY, an eminent mathematician and popular writer on the physical sciences, was born at Jedburgh, 26th December, 1780. She was the daughter of Admiral Fairfax, who was knighted for his services at Camperdown and elsewhere. During his absence on foreign service she was brought up at Burntisland, in Fifeshire, by her mother, a daughter of Samuel Charters, solicitor of the customs for Scotland, a woman, it is said, of great piety and force of character, but apparently not a friend to education. Mary's appears to have been neglected till the age of ten, except in regard to domestic economy, but from her own observations on the sea-side she began already to acquire a taste for natural science. At ten she was sent to a boarding-school at Musselburgh, where she spent a year to little advantage, although she had acquired a taste for reading. She learned the use of the globes from the village schoolmaster, and spent much time in studying the position of the stars in the heavens. She also learned pianoforte playing and drawing; and, encouraged by her uncle, Dr. Somerville, minister of Jedburgh, began to study the classics, and

acquired a respectable knowledge of Greek and Latin. It was only, however, when she became acquainted with mathematics that she discovered the true bent of her genius, and in this study she made rapid progress. In 1804 she married Samuel Greig, Russian consul for Britain, a relative of her own. The marriage was not a happy one, as her husband, though he did not interfere with her studies, did not sympathize with them. Her husband died three years after, and she returned with two children to her father's house in Burntisland, where she had the means of pursuing her studies without interruption. In 1812 she married her cousin, William Somerville, son of the minister of Jedburgh, who was appointed head of the army medical department of Scotland, and with whom she settled in Edinburgh, until in 1816, on his appointment to the army medical board, they went to reside in London. Until 1827 Mrs. Somerville, though widely known for her scientific acquirements, had as yet made no attempt at authorship. It was at the request of Lord Brougham, and with the object of popularizing Laplace's *Mécanique Céleste* for the Society for the Diffusion of Useful Knowledge, that she prepared her first work, *Mechanism of the Heavens*. It proved above the class for whom it was intended, and was published independently in 1831. It was adopted as a text-book at Cambridge, where it was largely circulated. This work, so remarkable for a woman, brought her many honours, and in 1835 a pension first of £200 and afterwards of £300 a year from government. She gave a preface to this work on the relation of the sciences, which she afterwards expanded into a separate work—*The Connection of the Physical Sciences* (1834). This work has been highly spoken of by scientific men, has been translated into the principal European languages, and widely circulated in English. Soon after the publication of this work she removed with her family to Italy, where she resided successively at Florence, Rome, and Naples, and the last of which she made her permanent residence after the death of her husband. Here she occupied herself with the preparation of a general work on physical geography, which was published in 1848, and has enjoyed great popularity. The revision of successive editions of her works also afforded her constant employment. In 1869 she published a new work on *Molecular and Microscopic Science*. She died at Naples on 29th November, 1872. The *Athenæum*, in a review of her works, expresses the opinion that with all her great acquirements and unquestioned command of the most intricate processes of the higher methods of mathematics, together with an excellent literary style, she was destitute of originality, and even of that comprehensiveness of method necessary to the success of a popular scientific work. Her attainments were recognized by admission to many learned and scientific societies, British and foreign.

SOMME, a department of France, bounded north by Pas-de-Calais, north-east by Nord, east by Aisne, south by Oise, south-west by Seine-Inférieure, and north-west by the English Channel; area 2379 square miles, of which 1855 are arable, 587 meadow, 206 woods, and hardly 1 of vineyards. Hardly any mines are worked, and the manufacturing industry is small. It is drained chiefly by the river to which it owes its name. The greater part of the department belongs to the upper chalk formation. The surface is slightly undulating, and the chalk frequently appears on it. In general appearance it is one of the least picturesque districts of France. It has a soil not naturally fertile, but improved by cultivation; and carries on a considerable trade, chiefly in corn, flour, oleaginous seeds, cattle, &c. The capital is Amiens. The department is divided into five arron-

dissements: Amiens, Abbeville, Doullens, Montdidier, and Péronne. Pop. (1901), 534,101.

SOMME, a river of France, which rises in the department of Aisne, 7 miles north-east of St. Quentin; flows south-west, enters the department of the Somme, flows north-west past Peronne, Amiens, and Abbeville, beyond which, about 15 miles, it falls into the English Channel. Its only affluents of the least importance are the Avre and Celle, both on the left. Its whole course is about 135 miles, of which 30 miles, commencing at Amiens, are navigable. By the canal of Somme and that of St. Quentin it communicates with the Oise and the Scheldt.

SOMNAMBULISM, or SLEEP-WALKING, the name applied to a peculiar condition of the mind, in which amongst the many included phenomena those of motion and action, guided apparently by the internal conditions of dreaming, are amongst the most notable. In fact a good definition of the somnambulist state is that of regarding it as an 'acted dream.' Somnambulism, however, would appear to differ from ordinary dreaming in two particulars. Thus 'the train of thought,' to use Carpenter's words, 'is more under the direction of sensations derived from without; and secondly, the muscular system is so completely under the control of the mind as not merely to give expression to its emotional states, but also to act in responsiveness to its volitions.' One marked feature of somnambulism consists in the *unity or exclusiveness* of thought exhibited by subjects, in that whatever object or objects the mind of the somnambulist fixes itself upon it takes cognizance of these objects only, to the exclusion of all others. The train of thought of the somnambulist is, in accordance with this fact, a strictly continuous and logical one; and reasoning and other intellectual processes may be carried on definitely and consecutively, as if perfect volition were exercised. The somnambulist condition may merge into ordinary dreaming so insensibly that it often becomes very difficult to draw any distinct line of demarcation between the states. Talking during sleep by some physiologists might thus fall under the definition of somnambulist phenomena; whilst with others the process would be accounted as merely that of dreaming. One of the most astounding conditions witnessed in somnambulism is the acuteness and wonderful exercise of the *muscular sense*, and of directing under the most difficult and trying circumstances the voluntary movements of the body. Sleep-walkers have thus been known to make their way unaided, and of course unconsciously to themselves, over the roofs of houses, to maintain their equilibrium on the ledges of roofs and gutters of house-tops, and in other dangerous situations in which the senses and powers of the waking mind might be severely tried. They may write unerringly and calculate correctly, and solve problems in their sleep which have baffled the ingenuity of their waking moments. It is exceedingly doubtful if the exclusive train of ideas already remarked as characteristic of the somnambulist can be directed or guided into other channels by external circumstances—at least in *natural* somnambulism. In those analogous states of hypnotism (which see) and animal magnetism (which see), artificially induced, the train of thought may be guided or directed more or less completely at the will of the 'operators.' The causes of this curious condition are but imperfectly understood, although the closer study during late years of mental physiology has enabled us to appreciate more clearly the general conditions in the mind which may characterize this state. It presents an example of one of those states in which a *passive* condition of the mind exists with reference to external objects and sensations, accompanied by

an activity with regard to its own internal consciousness. The power of voluntary motion, as we commonly exercise it, and as affected by external objects, is suspended, the place of active volition being taken by the internal conditions which in the first place determine the ideas, and in the second prompt the physical actions in the carrying out of these ideas.

**SOMNATH**, a town of India, in Gujerat, on the south-west coast of the Peninsula of Kattywar, 210 miles north-west of Bombay. It occupies a beautiful and commanding site, and is in the form of an irregular quadrangle, inclosed on all sides except the west, where the sea washes it, with a ditch and a wall. This wall, which is  $1\frac{1}{2}$  mile in circuit, is of great solidity and strength, constructed of massive square stones without cement, and flanked with two round and thirty-six square towers. The space inclosed is far too large for the present inhabitants, who do not exceed 7000, and live amid splendid ruins, telling of a grandeur which has long since passed away. The great temple, to which the place was mainly indebted for its celebrity, stands on an eminence north-west of the town, and so completely overtops all the other buildings that it can be seen at the distance of 25 miles. It was stormed and pillaged by Mahmud of Ghazna, who found an immense booty within it, and carried off its sandal-wood gates, which, according to a prevailing tradition, he employed in embellishing his own tomb at Ghazna. The temple has never been rebuilt, and still remains a shapeless ruin; but a very extraordinary attempt was made by Lord Ellenborough, while governor-general, to give it back its gates, which were carried in ostentatious procession from Ghazna for this purpose, and would doubtless have been replaced had not the court of directors interfered to prevent it.

**SOMNUS** (Latin, 'sleep'), or **HYPNOS** (Greek), in ancient mythology, the god of sleep, son of Nox (Night) and twin brother of Mors (Death). He dwelt at the western extremity of the world, where the imagination of early poets placed all awful beings. His power is great, and both mortals and gods are subject to him. Some of the later poets describe him as a handsome youth, some as a dull and lazy god, whose dark abode no ray of Phœbus enters. He is sometimes represented with a wreath of poppies; sometimes with a horn, in which he carries dreams.

**SONATA** (*sonata* or *suonata*, Italian, from *sonare*, to sound) is a simple piece of instrumental music intended to express various feelings in different passages, according to the variety of expression of which the instrument is susceptible. It was originally designed for one instrument only, principally for the violin; afterwards for the piano almost exclusively. Subsequently sonatas were composed in which the piano or harpsichord is accompanied by other instruments; for instance, the violin or flute, horn, clarinet. The expression of the sonata is to be determined by the character of the instrument—a circumstance which modern composers have not sufficiently observed. In sonatas for several instruments the principal instrument is either only assisted (as is the case, for instance, with many sonatas for the pianoforte accompanied by the violoncello), or the instruments alternate, so as to make the sonata a dialogue of instruments. Formerly the sonata usually began with a lively passage, followed by an andante or adagio; then came a minuet with a trio (afterwards a scherzo); and lastly a rondo or presto; instead of the second, third, or last division, variations are also made use of. The old arrangement, however, is no longer adhered to, and sonatas are now written in two, three, or four divisions. But still it is a complete musical piece, in which the passages are connected by a common character. An easy or short

sonata is called *sonatina*. The most distinguished composers of sonatas are Bach, Haydn, Beethoven, Mozart, Mendelssohn, Clementi, Cramer, Hummel, Weber, Moscheles, Kalkbrenner, Field.

**SONDERSHAUSEN**, a town of Germany, the capital of Schwarzburg-Sondershausen, 34 miles N.N.W. of Weimar. The chief building is the palace, with gardens and a cabinet of natural history and antiquities. There are here a gymnasium, real-school, normal school, &c. Pop. (1900), 7054.

**SONDRIO**, a town in Italy, Lombardy, 57 miles N.N.E. of Milan, on the Mallerio, near its junction with the Adda, at the south foot of the Rhetian Alps. It has eight churches, a civil and criminal court, a gymnasium, theatre, hospital, and house of correction. Pop. 4496.

**SONG**, a short poem adapted to music. The length of a song is determined by the conditions under which it is sung. It is always understood that it should be suitable for being sung at once, either by a single voice or chorus, or by a set of voices in response to each other, in which case it is called a *part-song*. Hence a song is one of the shortest of poems, and the treatment of the subject in it must always be simple. It does not admit, like an opera or oratorio, of a complex development, for the singing of a song is always regarded as an undivided performance, with only momentary pauses between the verses, or the interposition of a symphony which is continuous with the melody, and forms a part of the musical treatment of the song. A short tale or sentiment ingeniously developed, with successive modifications in the different verses of the song, is the usual subject of the song-writer. Almost any subject, serious or humorous, may be adopted; but certain conditions are indispensable, both in the subject and in the treatment of it. It must be something that will quickly catch the sympathies of an audience, and it must be managed so as to keep them alive, otherwise the song will be a failure. A poem may be short and very beautiful, and yet quite unfit to be treated as a song. The art of song-writing has peculiar difficulties, and many excellent poets have entirely failed to write good songs, while admirable songs have been written by persons who have shown little capacity for more elaborate composition. A song is always an appeal to the passions, and a telling phrase, repeated with ingenious modifications, is often more effective than the most profound and original sentiments. There is much more, however, in song-writing than mere clap-trap. The writer who can, within a moderate compass, give, together with force and simplicity, the greatest breadth and variety of expression capable of musical interpretation, is the best song-writer. In this respect it appears to us that the writers of the Elizabethan age, and particularly Shakspeare, have excelled all their successors as English song-writers. A large proportion of the best songs in all languages are anonymous, being those called national songs. The great bulk of the subjects of these, as of all songs, are amatory or patriotic. The term song is seldom given in English to religious composition, but some of the Psalms of David are so called in our version.

The term song is sometimes also given to the musical melody to which the words of a song are set. The character of the melody should be similar to that of the song itself—that is, it should be simple and passionate. As there may be good poetry which does not bear the character of a song, so there may be classical music which is not adapted to form the air of one.

**SONG OF BIRDS**. The voice or song of birds is produced, like that of all higher Vertebrata, in a definite organ of voice or larynx (which see). In

Birds, however, the organ of voice is of double nature, and consists (see ORNITHOLOGY) of an upper and lower larynx, the latter or inferior structure being the organ in which the voice or song is actually produced. The upper larynx (see LARYNX) is partly bony and partly cartilaginous, and presents essentially the same structure as that observed in the larynx of man. Except in the Condor and some Vultures the lower larynx is always developed. It presents great varieties in size, form, and disposition of parts. Its bony elements consist essentially of developments and modifications of the lower rings of the trachea or windpipe, and these elements vary greatly in structure in the different groups and genera of birds. Cuvier was probably the first to clearly ascertain that the lower larynx was the true organ of voice in Birds. He divided the windpipe of a blackbird at about its middle, and prevented the passage of air through the upper larynx—the bird continuing to sing by means of the lower organ of voice, although the notes were less powerful than before the division of the windpipe. The structure of the upper larynx, apart from experimental demonstration, proves to us that it is incompetent to produce the song-notes; and its chief office must therefore appear to be that of modifying the song. Savart says its influence on the pitch does not extend more powerfully than to modify it a semitone. The lower larynx of the bird may be compared to 'a reed prefixed to a tube.' In most instances the lower larynx is a double organ. Its characteristic structure is the *semilunar membrane*, which is attached to the upper part of the bony structure known as the *os transversale*, which bounds the lower part of the windpipe. This semilunar membrane is in fact essential to the production of voice, as was proved by the experiments of Savart. It is best developed in the singing and speaking birds, and becomes relaxed in the production of flute-like or clear-sounding notes. The song of birds, like the notes of most, if not of all, other animals, is in a minor key. Usually the range of song-notes may be comprised within a single octave, but of course these limits may be, and frequently are, greatly exceeded. The Parrots, with a great range of voice, and possessing great vocal capabilities, possess an inferior larynx, which differs from that of most other birds in being *single* in its nature. In the production of the peculiar shrill whistling of parrots the glottis is probably passive or silent—the column of air vibrating as in a flute, where a vibration is communicated by the air and traverses the elastic walls of the tube. The imitative powers of many birds—for example, the Parrots, Jay, Magpie, Blackbird, &c.—necessarily bring into play a great variety of actions connected with the vocal organs; and it is not always easy or possible to explain the exact conditions which in any particular case determine the range or character of the song. See special articles on the different birds for the characters of their song, &c.

SONNET (Italian, *sonetto*), a species of poetic composition consisting of fourteen lines of equal length. It was used at an early period among the Provencals; and in the thirteenth century Count Thibaut de Champagne mentions it as a species of poetry universally used and known. A Provencal sonnet, written in 1321, and entirely conformable to the rules for this species of poem, in which William de Almarichi congratulates King Robert of Naples, is to be found in Nostradamus, from whom Crescimbeni borrowed it in his *Storia della volgar Poesia* (t. i.). In Italy the sonnet was naturalized about the middle of the thirteenth century, when Italian poetry became imbued with the spirit of the Provencal. Fra Guittone, of Arezzo (died 1295),

the first Italian poet of note, was also the first who gave to the sonnet, at least in Italy, that regular form which Petrarca (died 1374) carried to perfection and made a model. In France the sonnet was not cultivated after the extinction of the Provencal poetry until the sixteenth century; but the *bouts rimés* reduced it to a mere play on words. In Germany it first came into use in the first half of the seventeenth century. It has been since much cultivated there, but is not adapted for the language, on account of its poverty in rhymes. In fact the strict rules of the rhyme often compel the poet to accommodate the ideas to the expression, even in languages which, like the Italian, have a great number of rhymes for almost every final syllable; and in German, in which many final syllables have very few rhymes, there are many words which almost always are made to rhyme with certain others; so that the occurrence of one of them in a sonnet inevitably suggests to the reader what words are to follow, so as to destroy the great pleasure of rhyme. A sonnet may produce a good effect when the subject is well chosen, and naturally accommodates itself to the divisions of the poem; but it requires much skill to make it pleasing; and Petrarca himself sometimes becomes tame, from the constraints to which he is subjected. Goethe wrote but few, and their subject is the difficulties of the form, and the pleasure of overcoming them. The sonnet is often attempted by persons who find it easier to furnish rhymes than ideas; and the number of insipid sonnets in Italian and Spanish is immense. In English also there is an abundance of them. The most successful writers of English sonnets are Shakspeare, Milton, Drummond, Cowper, Bowles, Keats, Wordsworth, Mrs. Browning, Rossetti.

The sonnet properly consists of fourteen iambic verses of eleven syllables, and is divided into two chief parts: the first consists of two divisions, each of four lines (*quadrinario*, *quatrain*); the second of two divisions of three lines each (*terzina*). The quatrains have two rhymes, each of which is repeated four times, and, according to the Italian usage, either so that the first, fourth, fifth, and eighth verses rhyme, and, again, the verses between them, the second, third, sixth, seventh (*rima chiusa*); or, which is rarer, the rhymes alternate (*rima alternata*); or, what is still rarer, the first quatrain is written in the first way and the second in the second. In the two *terzine* there are either three rhymes, each twice repeated, or two rhymes, thrice repeated, in all positions. The Italians, who use hardly any form for lyrical poetry but the sonnet and canzone, have invented varieties of it, such as the Anacreontic sonnets, with lines of eight syllables, and those with a *coda*. The sonnet generally contains one principal idea, pursued through the various antitheses of the different strophes, and adorned with the charm of rhyme.

SONORA, one of the states of the Republic of Mexico, lying on the Gulf of California, on which it has several good ports. It is generally hilly, a large portion of it lying on the table-land. It abounds in mineral wealth: gold is found in washings and mines, and the silver mines are rich and numerous. The soil is fertile, and produces two crops a year. The climate is healthy, and not subject to great extremes either of heat or cold. Wheat, maize, beans, and pease are chiefly cultivated; tobacco is grown in all parts of the country; and in some parts the sugarcane is extensively grown. Guaymas is the principal port, and has a splendid harbour. The capital of the state is Ures. Hermosillo and Alamos are among the principal towns. Pop. in 1900, 220,553 (including a large number of uncivilized Indians); area, 79,021 square miles.

**SONSONATE**, a town of the republic of Salvador, Central America, about 50 miles w.s.w. of San Salvador. It has some handsome churches, and a trade in sugar and shell-work. Pop. 5000.

**SOO-CHOW**, a town of China, capital of the province of Kiangsoo, on a lake in the line of the Imperial Canal, and in the fairest and richest district of the kingdom, 125 miles south-east of Nanking. The town proper has walls 10 miles in circuit, is intersected by numerous canals, some of them crossed by handsome granite bridges, and among its most striking buildings are some pagodas and a temple. It was opened to foreign trade in 1895. Its chief foreign imports are opium, kerosene, and coal, and among the exports silk is the most valuable. Silk is manufactured in the town. Pop. above 500,000.

**SOODRAS** (*Sūdras*), the lowest of the four great castes of India—Brahmans, Kahatriyas, Vaisyas, Soodras. Some think that they are descendants of the aboriginal inhabitants of India, who were subdued by the Aryan invaders, while others think that at least a considerable portion of the original Soodras consisted of the slaves, servants, and dependents of the Aryans and were themselves of Aryan blood. They are chiefly farmers, gardeners, artisans, and labourers of every kind. See **CASTE**.

**SOOLOO**. See **SULU**.

**SOOSOOK**. See **SUSUK**.

**SOOT**, very finely-divided carbon, deposited from the smoke of burning substances. Lampblack is a soot usually prepared by igniting resin or pitch, leading the smoke and vapour through an iron tube, where the oily products condense, and then into a series of chambers, in which the carbon is deposited, the purest carbon being found in the chamber farthest from the point of combustion. Lampblack is used for printing and painting; ordinary soot is utilized for manure.

**SOPHIA**, or **TRIADITZA**. See **SOFIA**.

**SOPHIA, CHURCH OF ST.** The foundation of this magnificent temple in Constantinople was laid in the sixth century, in the reign of Justinian, on the site of earlier churches; and the work was completed by Anthemius Tralles, the most celebrated architect of his age, with the aid of Isidorus of Miletus. Anthemius was the first who undertook to erect a dome on four arcades: he chose for this purpose the form of a Greek cross. Twenty years after its dedication, in 558, the dome was shattered by an earthquake. Another Isidorus, nephew of the former, restored it, but raised it 20 feet higher than before, giving it an elliptical instead of a spherical form. The curvature of the dome is so slight that the depth is equal to only one sixth of the diameter, which is 115 feet; the crescent, which has supplanted the cross on the centre, however, is 180 feet from the ground. This flattened form of the dome has a fine effect. The ceiling of the dome over the twenty-four windows is ornamented with mosaic work. Besides containing four colossal figures, which represent seraphim, the ceiling is gilt all over, but is defaced by time. The arrangement of the capitals is not conformable to rule; they belong to no particular style, and have no entablature. With the principal dome are connected two half-domes and six smaller ones, which add to the general effect. The form of the building is a Greek cross, inscribed in a quadrangle; but the interior area from east to west forms an ellipse. The mass of the edifice is of brick, but it is overlaid with marble; the floor is of mosaic work, composed of porphyry and verd antique. The great pillars which support the dome consist of square blocks of stone bound with hoops of iron. The gallery round about is formed by sixty-seven columns, eight of which are

porphyry (from Aurelian's temple of the Sun at Rome). Eight others, of green jasper, are wrongly said to have been taken from the temple of Diana at Ephesus. The vestibule has nine bronze doors, ornamented with basso-relievos. The interior of the church is 243 feet in width from north to south, and 269 in length from east to west. The exterior of St. Sophia has many defects and incongruous additions; among others, four minarets, built since it became the chief mosque of the Turks (1453), have given it the appearance of an irregular mass.

**SOPHISTS**, the name of a school or congeries of schools of philosophers who appeared in Greece in the period immediately preceding and contemporary with Socrates. The sophists occupy the transition period between the elder cosmical philosophies of Greece and the subsequent systems, beginning with Socrates, Plato, and Aristotle, which were founded primarily on the study of the human mind as the perceiving, thinking, reasoning, and knowing subject. In the older systems the direct relation of mind to the objective universe did not receive prominent attention. The hypothesis of a unity in the external variety was assumed without dispute, and a theistic or materialistic interpretation of this unity formulated according to the tendency of the school. In this manner arose a succession of systems which were agreed in being artificial cosmogonies, unrelated if not hostile to the current traditions of religion, and, however superior to these current notions as the efforts of great minds to comprehend the relations of things, they were still unable to stand the inevitable criticism of comparison with fact. Of this comparison and criticism the sophists were the exponents, and its force fell both on philosophy and religion. But none of the sophists were really great men, at least in comparison with those who succeeded them, and they appeared in an age of political decline and social corruption.

The sophists have probably suffered somewhat in general estimation from the disputes of Socrates and Plato with them. To be known chiefly by the accounts of their opponents, and to be regarded as the foils and butts of the founders of systematic philosophy, were the inevitable results of such a controversy. The very name of the sophists has become a proverb for the substitution of the semblance for the reality of wisdom; but, on the other hand, some German philosophers, particularly Hegel, appear to have attempted too much in the way of their rehabilitation.

The direct services of the sophists to philosophy appear to have been small and negative. It is too much to attribute to them as a merit the introduction of subjective philosophy. This, as its simultaneous appearance in different schools proves, was no more than a necessity of the period to which they belonged. What chiefly marks the sophists was their incapacity to generalize the subjective element, in consequence of which they were not philosophers properly so called, but only the critics of a dying philosophy. From this also two further consequences ensued, that the tendency of the teaching of the sophists was mainly sceptical, and that while the chief point of convergence of their teaching, that which gives them the greatest claim to be considered as a school, was in an ethical direction, the influence of their ethical teaching was mostly mischievous.

But the sophists rendered to science and literature, and even indirectly to philosophy, much greater services than as philosophers they were able to render to philosophy. They have been not inaptly compared to the French encyclopædists. They belonged to all the liberal professions; they taught all the usual branches of knowledge. Some of them were distinguished as rhetoricians and grammarians, others as

men of science. They frequently made a profession of universal knowledge, and though from their overweening estimate of the newly-found subjective element of knowledge they carried this pretension so far as to profess to speak of subjects of which they knew nothing, all their pretensions were not equally frivolous. Rhetoric, to which they naturally gave undue importance, was systematically studied by them, and they supplied some of the earliest models of good Greek prose. They are accused, however, particularly the later sophists, of being not only superficial in their attainments, but mercenary, vain-glorious, and self-seeking in their aims.

The scepticism of the sophists was not a philosophical scepticism. It was not until the resources of the human mind had been thoroughly explored, and found at least apparently to fail, that such a scepticism could properly arise; but now, when the mind first appeared as a factor in the production of knowledge, the contradictions evolved from the discussion of its agency engendered a superficial preliminary scepticism based on a comparison of systems and a logical sifting of them, which was frequently little better than quibbling. To this preliminary criticism was due the exaltation of rhetoric, the profession of universal knowledge, the diffusion of scepticism, the defence of contradictory opinions, and especially the application of scepticism to law and religion, which mainly aroused the opposition of Socrates and Plato.

Protagoras of Abdera, the earliest and one of the most important of the sophists, was contemporary with Socrates, but considerably older; he applied the Heraclitan doctrine of the universal flux of all things to the mind, maintained the uncertainty of the existence of the gods and the relativity of all truth. Man, he said, is the measure of all things. That is true for the individual which for the time being he perceives or feels. Sense and the gratification of sense are the only relations which subsist between man and the external world. All opinions are equally true, and contradictories may be affirmed with equal authority. Protagoras is said to have been the first who taught for pay, and though he left his pupils to fix his remuneration according to the amount of benefit they had received he is said to have become wealthy. Gorgias of Leontini came to Athens in B.C. 427 as an ambassador from his native city. He affected great pomp, and studied to excel in the splendour of his rhetoric. Founding upon Zeno, he took a bolder stand in scepticism than Protagoras. His book was called, *Of the Non-existent or of Nature*; and his three cardinal propositions were that nothing exists, that if anything exists it cannot be known, that if it could be known it could not be communicated. Gorgias reaches these conclusions by a logical quibble, in which he plays off Heraclitus against the Eleatic school. The scepticism of Gorgias, however, like that of other sophists, as it was founded on a superficial logic, was neither very profound nor very consistently developed. His successors applied it chiefly in a moral direction, which made Plato call the art of rhetoric as taught by Gorgias a corruption of justice. Hippias of Elis represented the law as a tyrant in compelling men to act contrary to nature. Thrasymachus made the gratification of desire the natural right of the stronger and might the law of nature. Critias, one of the thirty tyrants, ascribed faith in the gods to the invention of politicians. Prodicus of Ceos taught a morality more in accordance with ordinary conceptions of right. Some of his moral discourses are preserved, and are still admired for the feeling they display. His teaching was recommended by Socrates, and he has sometimes been called his predecessor. Prodicus is said to have been exorbitant in his charges for instruction. He taught rhetoric to Euripides.

SOPHOCLES, the second in order of time of the three great Greek tragic dramatists, was born, according to the best authority, in the second year of the seventy-first olympiad, B.C. 495. He was a native of Colonus, a village about a mile north-west of Athens, the scenery and associations of which, described in his last work, appear to have made a powerful impression on his mind. The rank of his family is not known, but he received an education equal to that enjoyed by the sons of the best Athenian families, being carefully trained in music and gymnastic, the two chief accomplishments. In personal appearance Sophocles possessed all the advantages which contribute to the perfection of physical education, so much prized by the Greeks. His only defect was a weakness of voice, which unfitted him for the stage. It is said that at fifteen years of age he was selected to lead the dance, naked and with lyre in hand, at the inauguration of the trophy erected at Salamis of the great naval victory achieved there. This story is rendered doubtful by its association with other two—Æschylus is said to have been present at the battle of Salamis, and Euripides to have been born on the day on which it was fought. Sophocles first appeared as a dramatist in B.C. 468, when he took the first prize in competition with Æschylus. To this result political causes probably contributed, as the judges belonged to the party to which Æschylus was opposed, and with which Sophocles was in sympathy. Æschylus retired to Sicily, and only returned to enter again for a brief period into the lists with Sophocles. Sophocles accordingly held all but undisputed supremacy until the appearance of Euripides, who took the first prize in 441. Sophocles, however, excelled both his rivals in the number of his triumphs. He took the first prize twenty or twenty-four times, the second frequently, the third never. In B.C. 440, owing probably to his connection with Pericles, he was chosen one of the ten strategi in the war against the aristocratic party of Samos. He did not prize himself much on military capacity, and appears to have readily deferred to the judgment of others. His name appears again in B.C. 413 (but it is doubtful whether he or another Sophocles is meant) as one of the ten councillors appointed to provide for the public safety after the destruction of the army in Sicily. In his old age he suffered from family dissension. His son Iophon, jealous of the favour he showed to his grandson Sophocles, and fearing he himself should suffer from it in the disposition of his property, summoned him before the judges, and charged him with being incompetent to manage his affairs. In reply he read a part of the chorus of his *Œdipus at Colonus*, which he had just composed, and at once proved that his faculties were unimpaired. Sophocles died about the age of ninety. One hundred and thirty plays in all are ascribed to Sophocles, of which seventeen are supposed to be spurious. Besides Æschylus and Euripides, he contended with Choerilus, Aristias, Agathon, his son Iophon, and others. Eighty-one of his dramas, including all those now extant, were brought out after he had attained the age of fifty-five. Only seven are now extant, the probable chronological order of which is Antigone, Electra, Trachiniae, *Œdipus Tyrannus*, Ajax, *Philoctetes*, *Œdipus at Colonus*. Sophocles brought the Greek drama to the highest point of perfection of which that form of art is susceptible. He introduced some important changes in the form of the drama; brought a third actor on the stage, two only having previously been allowed to appear at once; and made some important modifications of the choruses. It tended to the perfection of the drama that Æschylus, Sophocles, and Euripides at once adopted each other's improvements. His subjects

are human, while those of *Æschylus* are heroic, and in his management he shows himself a perfect master of human passions. The tendency of his plays is ethical, and he subordinates the display of passions to an end. Euripides made a further step, and represented in his tragedies human passions and even humours without any higher end than the depicting of character. Sophocles also introduced scenic illustration.

We give a short summary of the subject of the extant plays of Sophocles:—In the *Ajax* we see that hero, wounded in his honour by Ulysses in the contest for the armour of Achilles, seized with frenzy, on recovering from which, as if blinded by the dreadful discovery, he destroys his own life. The *Electra* belongs to the tragic scenes of the family of Pelops. It contains the murder of Clytemnestra (who, with her lover *Ægisthus*, had assassinated her husband *Agamemnon*) by the hand of her son *Orestes*, under the direction of his sister *Electra*. By the art of the poet, *Electra*, who would naturally appear as a subordinate character, is made the heroine of the action. In *Antigone* we see the highest triumph of female tenderness. *Antigone*, the wretched daughter of the wretched *Œdipus*, and guilty of no crime but that of attaching her own fate to that of her father, is the only being in Thebes who does not submit to Creon, the new sovereign. Her heroism is of the highest and most feminine character. Her brother *Polynices*, who was slain before Thebes in a single combat with his brother *Eteocles*, in which both fell, and whose burial had been prohibited by Creon, received the funeral rites at the hands of his sister. After performing this last office of affection with the tenderness of a woman, but an unshaken firmness, she resigns herself to the tomb which the tyranny of Creon has prepared for her. The King *Œdipus* and *Œdipus* at *Colonus* are parts of one story, and the tragic points in the history of *Œdipus* are thus exhibited in a terrific double picture. These tragedies are founded on the principle that man cannot escape his destiny, and that the profoundest wisdom only draws the cords of fate more tightly, till that almighty Power is appeased by voluntary penance and humiliation. In the former a dreadful mystery is suddenly revealed, while the wretched victim trembles to behold the unwelcome light. The unconscious patricide and husband of his mother, as one veil after another falls away, hurries back to the darkness, which has been removed from around him, by tearing out his eyes, and flees into miserable exile. The counterpart of this moving picture is drawn in the *Œdipus* at *Colonus*, where we see the hapless king weighed down by guilt and age. The darker lines of the horrible event are now softened by time. His involuntary crime has been expiated by long sufferings. In the grove of the avenging goddesses, by whom the whole dreadful tissue had been woven, his wretched wanderings end. *Œdipus* finds at *Colonus*, near the walls of Athens, in the solitary abode of the Furies, rest and a grave. The *Trachinians* is founded on the history of *Hercules*. *Dejanira*, in the excess of her love, becomes the murderer of the hero, who is taken, as it were, in the snares of fate itself, like *Agamemnon*, only that in the latter case the victim is more innocent than *Hercules*, and in the former the murderer is more guiltless than *Clytemnestra*. In the last play we find *Philoctetes*, the heir of the weapons of *Hercules*, suffering from an envenomed wound, and languishing on the island of *Lemnos*, where he had been deserted by the ungrateful Greeks during a magic slumber, which, after every attack of pain, gave him some relief. But at length his aid is required by the Greeks, as it was

decreed that, without the bow of *Hercules*, Troy could not be taken. This exposes him to new sufferings. *Neoptolemus*, the generous and worthy son of *Achilles*, is appointed to rob him of his quiver, and thus compel the defenceless *Philoctetes* to go against Troy. But the frank and honest *Neoptolemus* is incapable of carrying on such a design, and *Hercules* now appears, bringing reconciliation, promising health, and persuading *Philoctetes* to pardon the ingratitude of the Greeks, and to comply with their request. The beautiful rather than the strange and awful, as in *Æschylus*; than the tender, as in Euripides, is the predominant feature of the plays of Sophocles. The characters of Sophocles are undoubtedly the most perfect, distinct, and individual that can be drawn, and at the same time arrayed in all the charms of ideal representation. His choruses have always been celebrated as the finest productions of dramatic poetry. No tragic poet in ancient or modern days has written with so much elevation and purity of style. The versification of Sophocles stands alone in dignity and elegance, and his iambics are acknowledged to be the purest and most regular. Of the editions of Sophocles that by Prof. Jebb (with English translation) stands at the head.

SOPHONTSBA. See MASINISSA.

SOPRANO, the highest register of female voices. Its ordinary range is from C below the treble staff to A above it. Professional singers frequently go four degrees of the scale higher, namely, to E. F is attained only in extraordinary instances. The mezzo-soprano register is from A to F, that is, a third lower than the soprano.

SORAU, a town of Prussia, in the province of Brandenburg, 50 miles S.E. of Frankfurt. It is well built, and has two castles (one built in 1207), a fine Protestant church of the fourteenth century, other interesting churches, a gymnasium, lunatic asylum, orphan asylum; and manufactures of woollen and linen cloth, hosiery, drain-pipes; a dye-work, breweries, &c. Pop. (1855), 13,668; (1895), 14,814.

SORB-APPLE, the fruit of the service-tree. See SERVICE-TREE.

SORBONNE, a celebrated institution founded in connection with the University of Paris in 1252 by Robert de Sorbon, chaplain and confessor of Louis IX. The college was designed for the benefit and accommodation of certain secular priests who should devote themselves to the study and gratuitous teaching of theology. From the celebrity of many of its doctors, and the crowds of students that repaired to it, it came to exercise a high influence in ecclesiastical affairs and on the public mind from the fourteenth to the seventeenth centuries. It was suppressed during the first revolution and deprived of its endowments. At the reconstruction of the university in 1808 the building erected for it by Richelieu (replaced by a splendid edifice erected in 1884–89), still called the Sorbonne, was assigned to the faculties of theology, science, and belles-lettres.

SORGHUM, a genus of cereal grasses, with monœcious panicle flowers; glume coriaceous, cartilaginous, two-flowered. They form tall grasses, with succulent stems; are found in tropical parts of Asia, and in the warm regions of Europe. The *Sorghum vulgare* goes under different names in the different countries in which it is cultivated. In India it is called *jowaree*; in Egypt and Nubia, *dhurra*; in the West India colonies it is called Guinea corn. Its size varies with soil and climate. In Egypt it seldom exceeds 5 to 6 feet, while Burckhardt professes to have seen stalks in his travels 16 to 20 feet long. The flowers come out in large panicles at the top of

the stalk, and at first resemble the male spikes of the maize plant. They are succeeded by roundish seeds, the colour of which in some cases is a milky white, with a black umbilical dot; in others the seeds are red, but in both cases they are wrapped round with the chaff, and are better protected than other kinds of millet from the birds. It is largely cultivated in China and Cochin-China. The climate of England is not sufficiently dry and warm for ripening the seeds, but it has been occasionally cultivated artificially. The *Sorghum saccharatum*, or yellow-seeded millet, is a native of India, and is also cultivated in China, Cochin-China, and elsewhere, partly as a source of sugar. See MILLET.

**SORREL** (*Rumex acetosa*), a plant belonging to the natural order Polygonaceæ, which has long been used as salad. The leaves have an acid and slightly astringent taste from the presence of oxalic acid, are cooling, and possess antiscorbutic properties. They are often put in refreshing drinks, and administered in cases of fever, &c. The stems are upright, 1½ or 2 feet high, provided with a few petiolate, oblong, narrow-shaped leaves on the inferior part of the stem, and lanceolate, sessile ones above. The flowers are reddish or whitish, and are disposed in branching upright racemes. The Sheep's Sorrel (*R. acetosella*) is less than the preceding, but resembles it in habit as well as in its properties.

**SORREL-TREE** (*Andromeda arborea*), a tree belonging to the natural order Ericaceæ. This American tree sometimes attains the height of 50 feet, with a trunk 12 or 15 inches in diameter. It inhabits the range of the Alleghanians from Virginia to Georgia. The leaves are 4 or 5 inches long, oval- acuminate, and finely toothed. The flowers are small, white, and disposed in long one-sided racemes, clustered in an open panicle. The name has been applied on account of the acidity of the leaves.

**SORRENTO**, a seaport of Italy, on the south side of the gulf, and 17 miles S.E. of the city of Naples. It is surrounded by ancient walls, and has a cathedral and several other churches, manufactures of silk, and carries on an active trade. Sorrento was the birthplace of Tasso. Pop. 8000.

**SORTES BIBLIÆ, SORTES VIRGILIANÆ.** See BIBLIOMANCY.

**SOTTEVILLE-LES-ROUEN**, a village of France, so near Rouen as to be properly one of its suburbs; with manufactures of soap, glue, chemical products; railway-works, and several spinning-mills. Pop. (1886), 13,628; (1896), 15,987.

**SUDAN, SUDAN, or BELED-ES-SUDAN**, Land of the Blacks, Nigritia or Negro-land, has since the middle ages been the common name of the vast extent of country in Central Africa which stretches southward from the Sahara to 5° north of the equator, and has the Atlantic on the west, the Red Sea and Abyssinia on the east. The name was originally applied by the Arabs, and has been used with great latitude of signification. Great part of the region is well watered and wooded, and has a luxuriant tropical vegetation. It is partly level, partly undulating, and partly broken by chains of hills. In the west, where it is watered by the Niger and many other rivers, it often assumes a cultivated and well-peopled appearance. The inhabitants comprise numerous nations of different races, chiefly of the Negro, Fulde, or Fellatah stems, together with Arab colonists and traders. France and Britain own large territories there.

Egyptian rule was extended to the Eastern Soudan in the early part of the nineteenth century by Mohammed Ali, under whom Ibrahim Pasha carried it as far south as Kordofan and Sennaar. The Arabs sullenly submitted so long as their slave-

trade was not interfered with; but when Ismail Pasha was induced, under European pressure, to issue a proclamation against slavery, he alleged the necessity of extending his sway to the parts whence the traders obtained their supplies. An Egyptian expedition under Sir Samuel Baker in 1870 thus led to the conquest of the equatorial provinces, of which Colonel Gordon was appointed governor-general in 1874. By treating the people justly, listening to their complaints, and repressing all who defied the law, the governor-general accustomed the Soudanese to a much higher standard of government than any that had hitherto prevailed there. On the fall of Ismail, however, Gordon was recalled, his policy reversed, and hordes of Turks, Circassians, and Bashi-Bazouks were let loose to plunder the Soudanese. Egyptian misrule became intolerable, and in this crisis appeared Mohammed Ahmed of Dongola, an enthusiast who gave himself out to be the Mahdi, the long-expected Redeemer of Islam. During 1881-82 the Mahdi destroyed nearly every Egyptian force sent against him, but in the spring of 1883 elaborate preparations were made to suppress the rebellion. A well-equipped army, organized and commanded by Colonel Hicks, an old Anglo-Indian officer who had entered the Egyptian service, began its march up the Nile in September with the intention of striking at once at El Obeid, the head-quarters of the Mahdi. But, after enduring many hardships, Hicks' army was led by a treacherous guide into an ambuscade and annihilated. Colonel Coetlogon, the British officer at Khartoum, at once adopted defensive measures, and called in as far as possible the outlying garrisons. After some further reverses the British government advised the khedive to relinquish the country south of Wady Halfa or the second Nile cataract. English troops were sent out to relieve the garrisons of Eastern Soudan, and General Gordon undertook to effect the withdrawal of the garrisons of Khartoum and other places, unaccompanied by English troops. In a short time he was shut up in Khartoum, and in the autumn of 1884 a British force under Lord Wolseley was sent up the Nile to effect his relief. This expedition was too late to accomplish its object. Khartoum was stormed by the Mahdists in January, 1885, and Gordon was butchered.

After the successful revolt of the Mahdi the Red Sea and Somali possessions of Egypt were occupied by Italy and Britain respectively, and Darfur threw off the Egyptian yoke, but the equatorial province was held by Emin Pasha till he was relieved by Stanley. In 1896 an Egyptian force under the sirdar, Sir Herbert (now Lord) Kitchener, proceeded up the Nile, occupying Dongola on Sept. 23 of that year, and taking possession of Abu Hamed and Berber during 1897. Early in September, 1898, the Mahdist forces, under the command of the Mahdi's successor, the Khalifa, were completely defeated at the battle of Omdurman, and Khartoum was reoccupied by the Egyptian forces. About the same time the question of the southern limit of the Egyptian Soudan was raised by the occupation of Fashoda, a little north of the Sobat river, by a French force under Major Marchand. By an Anglo-French agreement in 1899 the western boundary was drawn so as to leave Wadai to France and Darfur and the Bahr-el-Ghazal to the Egyptian Soudan. In the same year the 22nd parallel of latitude was declared to be the northern boundary of the Egyptian Soudan, which is now under the joint government of Britain and Egypt.

**SOUL**, the rational and spiritual part in man which distinguishes him from the brutes, the indwelling spirit of man, which is both immaterial

and immortal. Soul is sometimes used as synonymous with *mind*, but generally it is used in a wider sense, as being a whole to which pertain the faculties constituting mind. Soul and *spirit* are more nearly synonymous, but each is used in connections in which it would generally be improper to use the other. In such passages of the New Testament as 1 Thess. v. 23, 1 Cor. xv. 45, and Heb. iv. 12 a distinction is implied between the terms soul and spirit, the former denoting a less completely spiritualized being than the latter. Nearly all philosophical systems are agreed in regarding the soul as that part of man which enables him to think and reason, and renders him a subject of moral government; but they differ when it comes to a question of origin, and also in regard to many points of detail. The great preponderance of usage limits the term soul to human beings, but there have been, especially in ancient times, many philosophers who ascribed souls to the lower animals and to plants. Plato defines the soul as a self-moving activity, and distinguishes (1) the appetitive soul, seeking the gratification of desire; (2) the courageous or irascible soul, manifested in combative activity; (3) the rational soul, which is the soul in its perfection, and which alone is immortal. The question of the unity of the human soul has often been debated. Is the soul one or more than one; is it a complex or a simple unity? Space will not permit us to go into all the possible developments of this question, or to enumerate all the actual replies which have been made to it. Some of them are, however, too important to be omitted. The vital functions of organic life are performed to a great extent unconsciously, hence the question has arisen, Are these performed by some organic principle differing from the self-conscious or intelligent principle in man? Is the thinking mind identical with the living animal principle, or is it distinct from it? This question has been broadly answered by some philosophers, and by a still larger number of theologians, by assigning to man two distinct souls, an animal or instinctive and a reasoning one. This has the convenience of answering all questions as to the analogies between men and brutes, but it is subject to the disadvantage that consciousness can discover no trace of this double vitality, so that if we are to attribute sensation to the lower soul we must be unconscious of it; if to the higher we must give both to the animals as well as to ourselves; in other words, we cannot draw such a line between instinct and reason as is implied in this theory: on the contrary, we attribute to conscious reason many actions which we see the animals perform by what we call instinct. Many more subtle and ingenious theories of plurality or complexity of the soul have been propounded. Plato attributed to it three parts or elements, and others have endowed it with a larger number. Those who have drawn distinctions of this kind have not been uniform in their use of terms; thus the term soul has been sometimes used to signify the lower, sometimes the higher principle in a complex vitality.

The simplicity of the soul has been maintained by many philosophers, who have made it the ground of their argument for its immortality. Many of the philosophers who have taken up this position, indeed, support the doctrine of a complex or plural source of the complex operations of organic life; but they apply the term soul to the highest vital principle or element, which alone they regard as immortal. This is the favourite argument of those who maintain the inherent immortality or indestructibility of the soul. It appears to have been one of the positions of Plato, who, however, supported the immortality of the soul on many different and independent grounds. As an

argument for the individual immortality of the soul it is wholly without validity; for we have here to do not only with a mere hypothesis, but with a hypothesis which, if it could be proved, would not support the deduction drawn from it. Those who maintain the inherent indestructibility of anything on account of its simplicity are bound on the same ground to maintain that it has always existed; for the same power which could bring a new element into existence should also, it would appear, be capable of destroying it. The permanent element, therefore, must either have existed in a being who always had existence, that is in God, or it must have been self-existent. If prior to the individual existence of the soul it existed in the Divine nature it may be resumed into it again, and the individual life terminated. This is the doctrine of emanation which prevails generally in the philosophies and religions of the East, and which is not unknown to the philosophy and mythology of Greece. It is a doctrine perfectly consistent and reasonable in itself; but it says nothing for individual immortality. If we suppose the individual soul to be self-existent we are met with another difficulty. From the simplicity of the soul we must assume its identity with the thinking mind. It is thus a being whose essence consists in self-consciousness. We ought, therefore, to have a distinct recollection of its previous existence. Pythagoras, it is true, remembered being the Trojan Euphorbus, but every one has not so good a memory as Pythagoras, and even Pythagoras could not pretend to remember an eternal existence. The doctrine of metempsychosis is inconsistent with the simplicity of the soul, as it implies a substratum which can be the ground of various disconnected intelligences—a sub-stratum, therefore, of which self-conscious intelligence is not the essence. Any supposed pre-existence of the soul which does not suppose its consciousness is equally inconsistent with its simplicity, and can only prove the indestructibility of an unconscious substratum, not of a conscious being.

The theory of indestructibility is maintained on different grounds by Christian philosophers from those of heathen philosophers. The former are compelled to admit the creation or emanation of the soul from God; they do not, therefore, maintain its pre-existence, yet indestructibility on the ground of simplicity is often insisted on by them. This argument has been ably maintained, though only as a probable one, by Butler in his *Analogy of Religion*. Butler's position is that death is the dissolution of the parts or elements of the bodily organism; that the soul being simple cannot be dissolved; that there is, therefore, no probability that the dissolution of the body should be the destruction of the soul, or that the soul from any other cause should cease to exist on the dissolution of the body. To this it may be replied that we do not know whether in the sense supposed the soul is simple or not; that our conception of death is not merely the dissolution of a compound body, but the ceasing to exist of something which has existed; that the soul as a self-conscious being has begun to exist simultaneously with the development of the bodily organism, and that it is possible that it may cease to exist when the dissolution of that organism has removed the only ascertained sphere of its conscious existence.

The philosophers who maintain the indestructibility usually also maintain the immateriality of the soul; but a whole host of philosophers, both in ancient and modern times, have assigned a material basis to consciousness. The effort of these philosophers in ancient times was commonly to assume some simple and elemental form of matter as the basis of thought. Sometimes, however, the conception of complexity,

or organism, which has become more popular in modern times, intervened. All the philosophers who, whether consciously or unconsciously, have held this view can tell us something positive about the soul. A long list of names might be given, exhibiting a plentiful diversity and also a plentiful iteration of opinions, which all agree in one thing, that they are without a shadow of evidence to support them. Whether the soul is a breath, a fire, a fluid, a harmony, or is composed of round atoms, is a question beyond the power of philosophy to determine. Of all the proposed physical constitutions we like best that of a German philosopher of the present day (an enemy of materialism), that the soul is an absolutely continuous, non-atomic fluid permeating the whole atomic structure of the body. If we could understand how an absolutely continuous fluid can permeate an atomic structure, and could conceive of the relation between fluidity and thought, we would gladly support this theory. Modern materialists usually make the soul not a particular, simple form of matter, but a result of organism. We do not understand whether on this hypothesis the soul is a distinct product of organism, or whether consciousness results directly from matter in a given stage of organization. Modern materialists are commonly physiologists, and the difficulties which are apt to perplex philosophers in regard to their views do not seem to occur to them. We know that none of the simple forms of matter exhibits the phenomena of consciousness, such as perception, memory, or volition. All the more important constituents of vital organisms are known, and have never been found separately to exhibit any trace of these qualities. We cannot, therefore, attribute consciousness to any of the forms of matter singly. It is equally difficult to attribute this power to organization, which is simply the coming or putting together of powers which exist separately in elements or parts. There remains only one other supposition, that organization produces consciousness because the elementary powers necessary to its production are contained separately in the elements. But what does such a constitution of elements imply? Necessarily it implies an antecedent power which designed them thus in relation to each other; for is it conceivable that intelligence should spring originally from an exact adaptation to each other of things without intelligence, and that the power of producing harmonious designs should result from an undesigned harmony in self-existing materials?

Leibnitz, instead of constructing souls out of matter, has constructed matter out of souls. The soul according to him is a monad, that is, a simple unextended substance with the power of acting. A monad differs from the atom of Democritus by the exclusion of extension, and the inclusion of activity. Monads are distinguished qualitatively by their active forces, which are ideas. A body is an aggregate of monads in a dormant condition, which appears to us as a whole through the confusion of our sensuous perceptions. The monads are indivisible, but God, who is a monad, creates other monads by fulguration.

Of the innumerable theories which other philosophers have propounded regarding the soul we can make only a brief selection. Aristotle defined the soul as the entelechy of the body—that is, its actual as opposed to potential existence. Each organ exists for an end, and that end is an activity; the end of the whole body is the soul. Similar to this is the definition of Trendelenburg, a modern German philosopher, who makes the soul an ethical organism, the ethical being a higher degree of organism, and an organism being differentiated from a machine in having its final cause within itself, and realizing itself from within outwards. Aristotle makes the

soul or reason separable from the body, and pre-existent. It is divine and immortal, but in what way it is related to the soul, or how its immortality affects individual existence, is not clearly defined. With the Stoics, who held all things real to be material, the soul, which is an emanation of the deity, consists of the warm breath within us. For the views of the Neo-Platonists see PLOTINUS. Origen agreed with Plato in ascribing pre-existence to the soul, and held that it descended into the body in consequence of moral delinquency. (See ORPHEUS.) Tertullian held, with the Stoics, that both God and the soul are material, but without detriment to their high nature. The soul has the same form as the body, and is delicate, luminous, and seriform in substance. It is corporeally communicated in generation, and afterwards develops. According to Augustine the soul is not material, and the body is not its prison. It is wholly present in the entire body, and in every part of it. All the faculties of the soul can be directed upon themselves, conscience can know itself, memory remember itself, and the will act upon itself. The immortality of the soul follows from its possession of eternal truth; sins rob it of happiness, but not of existence—both arguments of Plato, who said the immortality of the soul was proved by its not being destroyed by vice, which was most hostile to it. Occam did not identify the thinking mind with the sensitive soul, which he held to be extended and to consist of various parts dwelling in separate parts of the body. Bacon also held the existence of a spiritual and a physical soul. Descartes held the seat of the soul to be in the brain, and specifically in the pineal gland, because that organ is single, and not, like most other organs of the brain, a double organ existing on both sides. He held it to be immaterial, and incapable of direct communication with the body.<sup>1</sup> Its causal connection with bodily actions he ascribed to divine interposition. In this opinion he was followed by Leibnitz, whose monads consequently are incapable of communicating with each other. According to Kant the ideas of the soul as an enduring substance, the world as a causal series, and of God as an absolute substance and union of all perfections, which reason forms in striving to rise above the sphere of experience, have no validity, being all founded on logical paralogisms. Kant is himself a theistical philosopher, but in thus sweeping away the ground of all previous reasoning in favour of theism he has equally removed the foundation of his own. He gives to the ethical conscience a power of discerning God which he denies to reason. The writings of more modern German philosophers contain many ingenious speculations regarding the soul, into which space will not permit us to enter.

Considering the difficulties in which the subject is involved the majority of modern philosophers in Great Britain, following the example of the cautious founder of the Scottish school, have refrained from any inquiry as to what the soul is, and have contented themselves with asking what the thinking mind does. Is not this, however, an abdication of a proper function of philosophy, and does not the neglect of this question leave open a ready door to the assumptions of charlatanry? If psychology cannot answer determinately the question as to the origin of the soul it may be able to return a more determinate answer to another question, What is capable of being known regarding it? This is the question that ought to have been first put, and had philosophers expended

<sup>1</sup> It is difficult to understand why one situation should be preferable to another for a soul which can hold no communication with the body; but modern anatomists are said to have found that a man can live after this organ of the brain has been removed.

half the ingenuity upon it that they have done in propounding theories of an unattainable knowledge it would have been found that we are capable of acquiring some positive knowledge regarding the soul, and that this knowledge includes a limit, in one direction at least, to our inquiries.

We are incapable of imagining a material origin to the soul. It seems natural to imagine that sensation is explained by the delicate organization of a nerve, but when we begin to inquire whether it is the nerve which is conscious of the sensation or the brain to which it delivers it, we can give no reason for assigning consciousness to either of them. There is nothing in their known constitution which affords the faintest semblance of an explanation of such a thing as sensation, not to speak of memory and reason. We are equally incapable of imagining an immaterial source of consciousness. What is an unextended substance that thinks? the definition usually given by philosophers of spirit; and of what use to such a substance is an extended organism such as we find in the body? Descartes and Leibnitz were unable to conceive of any means by which two such unrelated existences could operate on each other, and imagined various plans by which it was done through the intervention of the Deity, forgetting that the Deity, being either spiritual or material, according to their definitions, must be in the same difficulty. It would thus appear that, in order to our discovering whether the soul is spiritual or material, we want the preliminary information of knowing what spirit and matter are. Moreover, all our efforts to think of the soul in any definite manner suggested by our experience involve contradictions. During all the time the subject has been under the consideration of philosophers not one attempt has been made to define the substance of the soul which is not open to this objection. After so long and so exhaustive a search, with a result so uniform, the attempt to define the substance of the soul may be pronounced, if not beyond our faculties, at least beyond our means of information.

But our inability to conceive of any definite substance as capable of thinking does not leave us at the mercy of conjectural hypothesis. Our ignorance on all parts of the subject is not equally great, and we can lay down conditions of speculation regarding it which shall at least set rational limits to conjecture. Had philosophers always been careful to inquire the extent of our actual knowledge we should have been saved a multitude of ideal theories which have disgraced rather than advanced philosophy. By the exercise of our senses we have discovered much regarding the constitution of matter, but much still remains unknown. We find organized beings of all kinds who give to us manifest signs of intelligence. We can trace such organisms to simpler forms of matter in which we find no signs of intelligence. Much of the process of building up an organism has been minutely traced out, though at every point in the process there are still impenetrable secrets. But in all that we have discovered of the behaviour of the elementary matters which compose an organism there is nothing to suggest that any of them brings into the combination the element of intelligence. We are justified in asserting, then, not merely from our inability to conceive of matter as thinking, but from actual investigation, that although we find organized material forms in which thought is present, intelligence is not a known property of matter, and whoever asserts that in an intelligent being there is nothing but organized matter asserts what he cannot prove, and has no ground whatever for thinking.

On the other hand, when it is asserted that the

soul is immaterial, if the meaning of this statement is that it is something different from anything which by the use of our senses and the exercise of our reason we have been able to discover in matter, we are bound to assent to it. It may even be asserted that the soul has none of the known properties of matter, and although it might be shown that it has properties analogous to some of the properties of matter we do not know that this can be positively contradicted. But when the advocates of the spirituality of the soul assert that matter and spirit have no common or related qualities we know that they assert what is contrary to fact. The assertion which has often been made by philosophers that like only can be known by like is absurd, and would imply either the identity of all objects and subjects or the impracticability of all knowledge; but what we have to do with matter is not only in the way of knowledge but in the way of relation. We not only know matter but we know through and by it, and it is to matter and its properties that we are indebted for the suggestion of many, if not all, our elementary conceptions. The relations between matter and spirit, whatever spirit is, are therefore intimate. There is nothing that we are capable of knowing more surely than this.

But our ignorance of absolute being does not prevent us from carrying our positive knowledge further in another direction. We know that the soul, as an individual intelligence, has had an origin, for it originated with the beginning of our organized life. We know that it was not self-originated, for nothing could originate in that which had no previous existence. We know that it could not have originated in any thing or any number of things without intelligence, for intelligence cannot spring from non-intelligence, which is its contradictory. We know that our soul is related to a bodily organism, which it is capable in many ways of controlling, and through which it is related to the entire physical universe; that in that universe it discovers a uniformity of laws through which it exercises an indefinite control over physical objects, extending in some measure to all with which it comes into communication. We know, therefore, that this universe is under the control of the Intelligence in whom our soul originated; in other words, that there is one Supreme Being, who is the author of all the harmony of being with which we are by our own participation in it made partially acquainted.

We are thus also enabled to return a definite answer to the question as to the immortality of the soul. If the soul has had an intelligent originator it is evident we can know nothing as to its duration without knowing the design or will of its originator. Psychology, therefore, furnishes the conditions of the problem of immortality, but does not answer it; it refers it to the higher science of theology. The end of philosophy is thus religion. If it does not end here it leads inevitably into the gulf of scepticism. It is, then, to the views of God supplied either by natural or revealed religion that we must look for light upon the question of the soul's immortality, and it was from this source that the best and surest arguments of such men as Socrates and Plato were drawn. The wide-spread belief in the immortality of the soul which is associated in almost all the religions and mythologies of antiquity with the conceptions of the moral nature and duties of man, whether we suppose it to be the remains of a primitive revelation or the instinctive deduction of human reason, cannot be held to be without weight in this question. But in natural religions we find two distinct theories of our relation to the Supreme Being, which have also been developed in philosophy, and which mate-

rially affect this question; these are the theory of emanation and the theory of creation. The theory of emanation affirms the indestructibility of the substance of the soul, but not the permanence of the individual life; the theory of creation makes the immortality of the soul a question simply of the continuance of the individual life. We have said that the theory of emanation is a self-consistent one; but is it consistent with fact? What is the emanation of one conscious being from another? Does it not imply a continuity of consciousness in the being thus formed with the being out of which it springs? Do we then, in emanating from God and returning to him, bring with us the consciousness of the divine nature, and carry back the consciousness of our individual existence? Our experience contradicts the former of these hypotheses, and we can therefore find nothing upon it in favour of the latter. Without these hypotheses the doctrine of emanation and re-absorption is simply an affirmation that a part of the divine nature, or something emanating from it, forms an unconscious basis of our consciousness, and that on its resumption our consciousness ceases. This is nothing more than a theory of creation and extinction. What is created is a consciousness; and as it consists with our knowledge that the individual consciousness had a distinct origin we appear to be shut up to the theory of creation. It is unnecessary for our present purpose that we should determine whether the mode of creation is that affirmed in the theory of emanation above-stated or not. It is sufficient to say that there is no necessary connection between the fact of the origination of a new life in this or any other mode and its subsequent resumption or extinction. The origin of this doctrine may perhaps be traced rather to the imagination than the reason, and it may be objected to it that it affords no satisfaction to those moral instincts which are the foundation of natural religion; that it is thus inconsequential, and does not spring from a sufficiently comprehensive view of our own nature. It is, however, in the Christian religion that we have the most distinct affirmation of the individual immortality of the human soul and of its responsible relation to the Divine Being, and it is thus by the authority of divine revelation that the dignity of human nature is most fully asserted and maintained.

**SOULS, CURE OF**, is an ecclesiastical charge in which parochial duties and the administration of sacraments are included. In the Church of England the cure of souls in each diocese is primarily vested in the bishop, the clergy of each parish acting as his deputies.

**SOULT, NICOLAS, JEAN DE DIEU**, Duke of Dalmatia, and Marshal of France, was born of humble parentage, at Saint Amans la Bastide, 29th March, 1769, in the department of Tarn, and in 1785 entered an infantry regiment as a common soldier. He soon raised himself from the ranks, and by the election of his regiment was created first lieutenant and then captain. At that time he served on the Upper Rhine, and greatly distinguished himself at Kaiserslautern, Weissenburg, Fleurus, and other places, and after successive promotions by different commanders, was named general of division by Masséna, to whose army he was attached, while it suppressed the insurrection in Switzerland, was victorious at Zürich, and compelled the Russians and Austrians to retreat. In the unsuccessful campaign in Italy he was severely wounded and taken prisoner, but obtained his liberty after the victory of Marengo, in 1800. In 1801 he was at the head of a corps of observation in Italy, and returned to France after the Peace of Amiens. In 1803 he had the command

of the largest of the three camps of the army of England, that at St. Omer. He was one of the marshals created immediately after the formation of the empire in 1804; and in the Austrian war in 1805 distinguishing himself at Ulm, and more especially at Austerlitz, where he commanded the right wing, and by making himself master of the heights decided the fortune of the day. He acquired new fame in the Prussian campaign; and in 1807, after the battle of Friedland, took Königsberg. After the Peace of Tilsit he returned to France, and obtained the title of Duke of Dalmatia. From 1808–12 he fought in Spain, but though he displayed all the talents of a great general, was overmatched by Wellington, and hence unable to gain many laurels. At first he commanded the centre of the main army, and took the lead in following the British under Sir John Moore, during their retreat to Coruña. In 1809 he succeeded Jourdan in command of the French army in Spain; defeated the Spaniards at Ocaña; forced through the narrow passes of the Sierra Morena into Andalusia; took Seville in 1810; and in 1811 fought the bloody battle of Albufera, which he would fain have magnified into a victory, but which his retreat proved to have been a defeat. In 1813 he was recalled from Spain, in consequence of Napoleon's disasters, to take the command of the fourth corps of the grand army, and commanded the infantry of the guard at Lützen, and the centre at Bautzen. On the news of Wellington's victory at Vittoria he was sent back to reorganize the French force, and did the utmost, with the inferior means at his disposal, to oppose Wellington's triumphant career, till further contest became unnecessary, in consequence of Napoleon's abdication. Soult gave in his adhesion to Louis XVIII., who appointed him commander of the thirteenth military division; and in 1814 gave him the portfolio of minister of war. The hostility of the royalists, however, soon compelled him to resign. On Napoleon's return he joined his standard, and held the post of major-general of the army in the campaign of Waterloo. After the second restoration he was obliged to quit France, and took up his residence at Düsseldorf. In 1819 he was permitted to return; and in 1827, during the ministry of Villele, was raised to the peerage. After the July revolution he held the portfolio of minister of war in the Lafitte and Périer ministries. In 1838 he visited England, as the representative of Louis Philippe, on occasion of the coronation of Queen Victoria, and was received with extraordinary distinction both by government and people. In 1839, on the overthrow of Molé, he received the portfolio of foreign affairs under the new ministry; during a subsequent administration acted as minister of war; and in 1846, on retiring from public life, was created Grand-marshal of France. Soult communicated valuable information to Napier and Matthieu Dumas for their histories of the Peninsular war. He died on 26th November, 1851. The first part of Soult's *Memoirs*, in three vols. 8vo, containing the history of the wars of the revolution, was published by his son in 1854.

**SOUUMY**, or **SUMY**, a town of Russia, on the right bank of the Psol, in the government and 83 miles north-west of Kharkov. It is surrounded by a fosse and earthen ramparts, and defended by a citadel; and has various churches, chiefly of wood, numerous distilleries, a large trade in spirits and agricultural produce, and four large annual fairs, which attract great numbers of dealers from distant quarters. Pop. (1897), 28,622.

**SOUND**. See **ACOUSTICS** and **EAR**.

**SOUND, THE**, or **ÖRESUND**, a strait which connects the Kattegat and Baltic Seas, and separates

the Danish Island of Seeland from Sweden. The name of Sound, however, is commonly confined to the comparatively narrow part of the passage, which, between Elsinore and Helsingborg, has a width of only 8 miles. Though the Great Belt affords a much wider and deeper communication between the Kattegat and Baltic, the Sound is that almost universally selected by vessels, partly because it is the shortest, and partly because there is a greater probability of meeting with favourable winds. The depth of water varies from 4 to 20 fathoms, but the channel is bounded on both sides by shelves and quicksands, which make the navigation by sailing vessels somewhat dangerous. The clearest passage is on the Danish side. The Sound duties, formerly levied by Denmark on vessels passing through, were abolished in 1857 by treaty with the commercial nations of Europe. See *ELSNORE*.

**SOUNDING**, the operation of finding the depth of the water and the quality of the ground by means of a plummet sunk from a ship to the bottom. Two plummets are used, one called the *hand lead*, weighing about 8 or 9 lbs.; and the other, the *deep-sea lead*, weighing from 25 to 30 lbs.: both are shaped like the frustum of a cone or pyramid. The former is used in shallow waters, and the latter at a greater distance from the shore. The lines employed are called the *deep-sea lead* and the *hand-lead line*. The hand-lead line, which is generally 20 fathoms in length, is marked at every 2 or 3 fathoms. Sounding with the hand lead, called *heaving the lead* by seamen, is generally performed by a man who stands in the main-chains, to windward. He holds the line nearly at the distance of a fathom from the plummet, and having swung the latter backwards and forwards three or four times, in order to acquire the greater velocity, he swings it round his head, and thence as far forward as is necessary; so that, by the lead's sinking while the ship advances, the line may be almost perpendicular when it reaches the bottom. The deep-sea lead has a longer line, marked at every 10 fathoms. To use this lead more effectually at sea, or in deep water on the sea-coast, it is usual previously to bring to the ship. The scientific investigation of the ocean and its bottom has rendered more perfect sounding-apparatus necessary, and has led to the invention of various contrivances for this purpose. Among the earliest of these is that invented about 1853 by J. M. Brooke of the United States Navy. Brooke's sounding apparatus consists essentially of a heavy shot perforated so that an open tube containing cut quills, with their open ends downwards, may pass through it, the tube being attached to a rod which has at its upper end a hook, over which passes a wire supporting the shot by means of a ring below it. The hook is movable, so that though it supports the shot when the apparatus is suspended from the sounding-line, it easily lets the wire slip off when the line is slackened on reaching the bottom. The rod and tube then slip through the shot, which is left behind, while the quills which have penetrated the soil at the bottom bring up some of it as a specimen. The shot merely serves as a sinker, and is left at the bottom. The sounder used during the *Challenger* expedition of 1872-76 was not unlike that of Brooke, but it had much heavier sinkers for the deeper soundings. The amount of lead left at the bottom after each sounding in very deep water was about 3 cwt. Besides the sinker and the apparatus for obtaining specimens of the sea-bottom, the line carried a deep-sea thermometer, a piezometer, a water-bottle to obtain a specimen of the water near the bottom, and other such instruments. Many ingenious devices have been employed for securing

specimens of the sea-bottom. Among these the *hydra*, invented by Captain Shortland, is worthy of notice. It consists of a tube with upward-opening valves at the lower end. When the sinker strikes bottom these valves open and admit some of the loose surface material, but when the line is pulled up they close by their own weight. Several inventors have devised sounders to be used without lines. Most sounders of this class consist of a lead attached to a buoyant self-registering apparatus, which becomes automatically detached when the lead reaches the bottom. Lord Kelvin introduced the use of steel wire in deep-sea sounding. It is less affected by friction than hempen cord, and allows of the use of a lighter sinker, and thus in most cases the sinker may be hauled up. The same inventor has devised a useful instrument for taking soundings rapidly in deep water while a ship is in motion. A pressure-gauge is lowered with the lead, and the depth is calculated from the indicated pressure. The gauge usually consists essentially of a glass tube open at the lower end, and coated internally with a coloured substance. The lower the tube descends the higher does the water rise in it, and the height of the water in the tube, indicated by the extent to which the coating has been washed off, is an exact index of the pressure to which the contained air has been subjected. (See *OCEAN*).—*In sounding* implies that the vessel is so near the land that a deep-sea lead will attain the bottom.—*Soundings*, that is, the depth of the water and the nature of the ground, are carefully marked in the log-book when they have been taken.

**SOUP**, a kind of liquid food, made of broth, or the juice of flesh, with various other ingredients.—*Portable soup* is a kind of cake, formed of concentrated broth, which, being freed from all fat, and, by long boiling, having the most putrescent parts of the meat evaporated, is reduced to the consistence of glue, and will keep sound for many years. In long voyages this has been found to be a most valuable article of food.

**SOURABAYA**, **SURABAYA**, or **SOERABAYA**, a seaport of eastern Java, capital of a province of the same name, situated at the mouth of the river Brantas, opposite Madura, fully 400 miles east of Batavia. It has the best harbour on the coast of Java, and is now the largest town and chief seaport of the island. It is strongly fortified, and contains the government dockyards and arsenals. Boats can ascend the river for a considerable distance, and thus the products of the fertile country behind Sourabaya reach the port easily. There is also railway communication with Batavia and the other chief places of the island. The leading exports are sugar, coffee, and rice. Oil-refining is carried on in the town. The number of vessels entering the port of Sourabaya in 1899 was 831, with a total tonnage of 960,116; and the number cleared was 836, of 964,704 tons. Pop. (1896), 125,000.—The province is very fertile, and has a population of 2,114,000.

**SOURAKARTA**, or **SOLO**, a town of Java, capital of the province of the same name, 140 miles w.s.w. of Sourabaya, to which there is a railway. It is the residence of two native chiefs, is defended by a strong castle occupied by the Dutch resident, and has a Protestant church, an educational institute, and other schools; and manufactures of cotton and other tissues, leather, harness, &c. Pop. in 1896, 104,600.—The province, which is central, is partly traversed by a mountain range, but consists principally of a fertile valley watered by several streams. It produces rice, coffee, tea, tobacco, sugar, and a variety of fruits. Pop. 1,236,263.

**SOUR-GUM**. See **TUPELO**.

**SOUR-SOP**. See **CUSTARD-APPLE**.





**SOUSDAL**, or **SUSDAL**, a town of Russia, in the government and 22 miles north of Vladimir, in a fertile plain on the Kamanka. It is a very ancient place, and consists of three quarters, one of which, called the Kremlin, is surrounded by earthen walls and a deep fosse in a very dilapidated state. It contains a handsome episcopal palace, now used as courthouses; six churches, several of them large and richly-decorated structures; three monasteries and two nunneries, a diocesan seminary, and almshouses; and has manufactures of woollen and linen cloth; and some trade. Pop. (1894), 7210.

**SOUTANE**, the common outer garment worn by the clergy of all ranks in the Roman Catholic Church. See **CASSOCK**.

**SOUTH, ROBERT**, a celebrated divine of the Church of England, the son of a London merchant, was born at Hackney in 1634, and educated at Westminster School and Christ Church, Oxford. In 1654 he addressed a copy of Latin verses to Cromwell, on the conclusion of peace with the Dutch; and the following year produced a poem entitled *Musica Incantans*. In 1660 he was chosen public orator of the University of Oxford, and soon after was nominated domestic chaplain to Lord Clarendon, then lord-chancellor. In 1663 he became a prebendary of Westminster, was admitted D.D., and obtained a living in Wales. On the disgrace of his patron he was made chaplain to the Duke of York. In 1670 he was installed canon of Christ Church; and in 1676 he went to Poland as chaplain to the English ambassador, Lawrence Hyde. On his return home in 1678 he was presented to the rectory of Islip, in Oxfordshire. In the latter part of the seventeenth century Dr. South commenced a controversy with Dr. Sherlock relative to the doctrine of the Trinity. Both disputants professed to be orthodox sons of the church, their difference relating to the mode of explaining the doctrine in question. Dr. South died in 1716. He possessed an abundant share of wit and humour, which he not unfrequently displayed in his most serious compositions. His sermons, which have been much admired, were published in eleven vols. 8vo. He also wrote an account of his journey to Poland, and other works. South's style, though colloquial, is brilliant and epigrammatic, especially distinguished by wit, but sometimes reaching sublimity; more poetical than fair in argument, but free from pedantry.

**SOUTH AMERICA** is a vast peninsula of a triangular form, with its apex south, extending in length from lat. 12° 30' N. to Cape Horn in lat. 55° 59' S. Its greatest length, from north to south, is 4800 miles; its greatest breadth, from east to west, 3230 miles. About three-fourths of it lie between the tropics, the remainder in the temperate zone. Its coast lines, particularly the west, are comparatively little broken or interrupted by indentations, excepting towards the southern extremity, where considerable inequalities occur on both the east and west shores. Here, also, is a group of mountainous islands, forming the archipelago of Tierra del Fuego. They are penetrated in every direction by bays and narrow inlets of the sea or fiords, ending often in glaciers formed from the snow on the summits of mountains 6000 feet high. Peat-mosses cover the higher declivities of these mountains, and dense forests their flanks. The mountainous and elevated tracts of this continent are chiefly limited to the borders of the Pacific and Atlantic Oceans; the intervening space being occupied by a wide and remarkably level plain, or rather series of plains, reaching from one extremity of the continent to the other, at an elevation generally less than 1000 feet above the level of the sea.

**Mountain Systems.**—There are four mountain systems in South America; the most remarkable of which is the Andes, that stretch along the west coast from south to north, in one continued chain of 4180 miles in length in a straight line, and 4360 when measured along the highest part of the system, commencing at the Straits of Magellan or Magalhães, and ending at the Isthmus of Panamá. They are of inconsiderable width, but attain great elevations, ranking in this respect next to the Himalaya Mountains; the highest peak yet known being Aconcagua, in the Argentine Republic, 23,080 feet high, though Sorata in Bolivia may be found to surpass it. The second system is that of Parime or Parima, also called the Highlands of Guiana, consisting of numerous irregular groups of mountains scattered over a table-land not more than 2000 feet above the sea, which extends 600 or 700 miles from east to west, separating the plains of the Lower Orinoco from those of the Rio Negro and the Amazon. The principal group extends from the parallels of lat 3° to 8° N., and from the meridians of lon. 58° to 68° W. The mean direction of the range is north, 85° west, and the separate chains follow, generally, nearly the same direction. The culminating points of this system are Mount Icutu, 11,000 feet high, Maraguaca (8230 feet), and Duida (8120 feet). The third system is known under the general name of the Coast Chain of Venezuela; the north chain of which contains the culminating point, Naiguata, 9130 feet high, with almost vertical sides. The fourth system is that of Brazil, which consists of two great ranges running parallel to the coast at various but not very great distances from the sea, and of numerous branches stretching far into the interior, and crossing the country in different directions. The higher mountains of Brazil extend generally, like the Andes, from south to north; those of the interior form a ridge, whose chief direction is from east to west. The culminating point of the highest chain of mountains in Brazil is Itatiaia, about 10,000 feet high.

Throughout the Andes, but especially in Chili and Ecuador, volcanoes, active and extinct, are numerous. The most notable of the active volcanoes is Cotopaxi, in Ecuador, which attains an elevation of 19,613 feet above sea-level. In form it is one of the finest of all volcanoes, being equalled only by Fuji-yama, in Japan. Near it is Sangay, also an active volcano, which is 17,464 feet high. Antisana, at present inactive, is not much lower than Cotopaxi.

**Plains.**—The plains of South America are of vast extent, stretching for many hundreds of miles without exhibiting the slightest perceptible inequality. In the rainy season they display a surface of beautiful green, but in the dry season assume the appearance of a desert. Then the grass crumbles into dust, the surface of the soil is rent; the crocodiles and larger serpents remain imbedded in the dried-up mud till the first showers of spring arouse them from their torpidity, when, says Humboldt, on the authority of the aborigines, 'the moistened clay on the margin of the swamps is sometimes seen to blister and rise slowly in a kind of mound; then with a violent noise, like the outbreak of a small mud volcano, the heaped-up earth is cast high into the air, and forth issues a gigantic water-snake or a scaly crocodile.' The great plains of South America are variously designated the Pampas of Buenos Ayres, the *Silvas* of the Amazon, and the *Llanos* of the Orinoco and Venezuela. (See **LLANOS**, **PAMPAS**, and **SILVAS**.) The Pampas of Buenos Ayres are about 900 miles in breadth, occupy a surface of 315,000 square miles, and lie about 1000 feet above the sea. Marked by its vegetation and other characteristics, from east to west, it has four distinct regions. The first, which extends 180 miles west from Buenos Ayres, is covered with thistles and

lucerne of the most vivid green, so long as the moisture from the rain lasts; the second, extending 450 miles, is covered with long grass, intermixed with gaudy flowers; the third is a tract of swamps and bogs; the fourth a border of thorny bushes and dwarf trees, reaching to the Andes. The grassy plains of this level territory are occupied by thousands of wild cattle and horses, who find there inexhaustible supplies of food. The thistles of this region attain an extraordinary size, shooting up to a height of 10 and 11 feet, with stems so strong, and armed with prickles so formidable, as to form an impenetrable barrier. The *Silvas* of the Amazon, lying in the centre of the continent, form the second division of the South American Lowlands. They are covered with wood (hence their name), and so densely that the country can be penetrated only by sailing up the river or its tributaries. They extend 1500 miles along the Amazon, varying in breadth from 350 to 800 miles. The heat is suffocating in the deep and dark recesses of these primeval forests, where not a breath of air penetrates; while a death-like stillness prevails from sunrise to sunset, when the forest suddenly resounds with the loud and wild cries of the animals by which it is inhabited. At midnight a profound silence again prevails, and continues till dawn, when the discordant uproar recommences. The *Llanos* of Venezuela, Colombia, and Guiana form the third division of the South American Lowlands. They are so perfectly flat that frequently there is not an eminence a foot high in 200 or 300 square miles. They are nearly destitute of trees, excepting the banks of the Orinoco, which are thickly wooded. The *Llanos* present very different aspects at different seasons of the year. Soon after the termination of the rainy season in October, and the subsidence of the swollen rivers, they are clothed with fine grass, affording abundant pasture to the countless herds with which they are covered. But in the dry season, namely, between November and February, they are converted into desolate wastes; all vegetation is destroyed, the waters are dried up, and the earth is rent in deep and wide crevices—a result, however, proceeding rather from the absence of moisture than from excessive heat, which, although very intense, is not so great as during the wet season.

Besides these three great tracts of level country, there is the Desert of Patagonia, occupying 162,000 square miles, the most barren of all the plains of South America; being, for the most part, composed of sandy sterile dunes, intermixed with stones and gravel; occasionally diversified by huge boulders, tufts of brown grass, low bushes armed with spines, brine lakes, incrustations of salt white as snow, and by black basaltic platforms. The climate of these plains is very cold, especially south from lat. 45° s., and is subject to great and sudden changes of temperature.

*Rivers.*—The principal rivers of South America are the Amazon, the Orinoco, and the Plata. The first is the largest river on the globe. It rises on the table-land of Pasco, in Lake Lauricocha, and, after a course of 4000 miles, falls into the Atlantic at the equator, in about lon. 51° w. The Orinoco rises nearly in the centre of the Parima Mountains. Its length is estimated at about 1500 miles. The affluents of the Orinoco are numerous, and some of them very large streams. The Orinoco is connected with the Rio Negro, an affluent of the Amazon, by a navigable river, the *Casiquari*, presenting, in this connection, one of the most remarkable phenomena of physical geography. The Plata (Rio de la Plata) is not so much a river as an estuary formed by the confluence of the rivers Paraná and Uruguay. Notwithstanding its great breadth, its navigation is difficult, owing to its shoals and strong irregular currents.

Its waters are so turbid that they tinge the sea visibly for 200 miles from the embouchure. There are a number of other rivers in South America, which, though not so large as any of those above named, are equal, if not superior in size, to most of the greatest rivers of Europe. Amongst these are the San Francisco, the Rio Negro, Colorado, Essequibo, &c. The water in some of the rivers in equatorial America is white; in others it is of a deep coffee colour, or dark green, when seen in the shade, and when ruffled by a breeze, of a vivid green.

*Lakes.*—The lakes of South America, of any considerable size, are few, and, with exception of the Lake Titicaca, are rather vast morasses than lakes; while the large inland water in Colombia, called the Lake of Maracaybo, is a mere inlet from the Caribbean Sea, and not a true lake. The Lake Titicaca is situated near the north-west frontier of Bolivia or Upper Peru; it covers an area of above 4000 square miles, is elevated 12,493 feet above the sea, and is said to be 120 fathoms deep in many places. Some of the temporary lakes, alternately inundated and dry, or in a marshy state, cover, when flooded, vast tracts of country; that of Xarayos, on both sides of the Paraguay and nearly in the centre of the continent, extends over 36,000 square miles. In the elevated mountain valleys and table-lands of the Andes there are many small lakes of the purest blue and green colours, and some of them intensely cold, being near the line of perpetual congelation.

*Climate.*—There are no parts of South America so hot as we should be led to expect from its geographical position—a result produced by the operation of the trade-winds, atmospherical influences of the huge chain of the Andes, and other physical causes. The burning heats of the plains of Arabia are unknown on the new continent. In the plains of Caracas, the hottest region of South America, the temperature of the air during the day is only 98° in the shade; while it rises to 112° in the sandy deserts around the Red Sea. Throughout the whole basin of the Amazon, which comprehends between 2,000,000 and 3,000,000 square miles, the climate is neither very hot nor unhealthful, though under the equator. This arises from its being shaded by lofty woods, and from the prevalence of a cool easterly breeze, a branch of the trade-wind, which ascends the channel of the Amazon, following all its windings nearly to the foot of the Andes. Brazil, and the country extending westward from it, enjoys also an equable and temperate climate. At Rio Janeiro the mean temperature is only about 74°. At Lima the temperature varies from 53° to 82°, but the mean for the whole year is only 72°. At Buenos Ayres the mean annual heat is 68°; and in the Straits of Magellan the temperature of the warmest month does not exceed 43° or 46°, while snow falls almost daily. The narrowness of the continent towards the south, the immense tracts of ocean which lie on either side of it, and its exposure to the rigours of the polar regions, sufficiently account for this inclemency. On the west coast there is a rainless district of nearly 1000 miles in length, from north-west to south-east. It lies between lat. 7° and 32° s., and lon. 65° and 68° w. The various climates, which so large a continent must necessarily possess, will be treated of more in detail in the articles on the various countries of which it is composed.

*Geology and Mineralogy.*—Granite forms the base of the whole continent, having gneiss here and there associated with it, but mica schist is the most common of the crystalline rocks. Quartz rock is much developed, generally mixed with mica, and rich in gold and specular iron. The pampas of Buenos Ayres are entirely alluvial. Granite prevails to the extent

of 2000 miles along the coast of Brazil, and, with evenness, forms the base of the table-land. The superstructure of the latter consists of metamorphic and old igneous rocks, sandstone, clay-slate; limestone, in which are large caverns with bones of extinct animals; and alluvial soil. Porphyry and red sandstone abound all over the Andes. Peru is the chief seat of the mineral wealth of South America. Chili, of which the former is but a continuation, is also famous for its mines of gold, silver, and copper. The province of Minas Geraes, in Brazil, is likewise, as its name implies, exceedingly rich in mines. Besides the mines there are some valuable gold and silver washings in Brazil and other parts of South America. Brazil used to produce many diamonds.

**Vegetation.**—Extending through so large a space, and possessing in consequence so great a variety of climate, no special character can be given to the vegetation of South America. As in the case of North America, the most distinguishing feature of the former is its prodigious forests, which cover about two-thirds of the whole continent; a large portion of them so dense, and so choked up by twiners, shrubs, and sharp-edged grasses, that a hatchet is necessary at every step to clear the way. These forests are in several remarkable particulars wholly different from those of the Old World. The trees are much more various, more graceful, and have more distinctive characters; and many of them, even the largest, are adorned with the most brilliant flowers: scarlet, purple, blue, rose-coloured, and golden yellow are blended with every possible shade of green. Throughout the whole of tropical America vegetation is on the grandest scale, combined with great beauty and fruitfulness. In those regions where there are due proportions of heat and moisture, the magnitude of the trees and the splendour of the flowers are extraordinary. 'Individual plants,' says Humboldt, 'language in our hot-houses can give but a very faint idea of the majestic vegetation of the tropical zone.' Fruits also abound, including oranges, limes, coconuts, pine-apples, mangoes, bananas, pomegranates, and many others. Southward of the line are found the quassia bitter, the fragrant tonga-bean, the beautiful rosewood, and the chinchona tree, the rind of which yields that most valuable medicine quinine; and indigo, coffee, the sugar-cane, maize, and the cacao-tree, from whose seeds chocolate is prepared, are amongst the products of South America. The cultivation of tea has been attempted, though there is a favourite native beverage, the Paraguay tea. In the south vegetation gradually loses its tropical character, and finally assumes the aspect of northern vegetation.

**Zoology.**—The most formidable beast of prey peculiar to South America is the *Felis onca* or jaguar. It is larger and stronger than the panther, but inferior in size and ferocity to the Bengal tiger. The puma or American lion is found in both North and South America. Apes and monkeys abound in the tropical forests of the latter, but are an inferior race to those of the Old World. The animals most characteristic of South America are the tapir, sloth, ant-eater, and armadillo. Amongst the winged mammals are bats known as vampire-bats, which live on blood, attacking the largest animals, and even man, when asleep. These dangerous creatures are fortunately not numerous, and are almost wholly confined to Guiana, Colombia, and Brazil. Of the birds of South America the most remarkable for size is the condor, a species of vulture. The largest specimen yet met with measured somewhat less than 14 feet between the extremities of the wings, though they rarely exceed 11. The body of the largest individuals is generally from 8 to 8½ feet in length from the tip of the beak to the extremity of the

tail. They inhabit the most inaccessible parts of the Andes. South America possesses, in common with other countries, eagles, vultures, falcons, and other birds of prey. It also possesses many birds of exquisite plumage, amongst these the tiny humming-bird and the graceful couroucou ( *Trogon pavoninus* ), with its splendid robe of green. The seas, lakes, and rivers of South America abound with fish of various kinds; and many of the latter, in the tropical regions, with enormous lizards and alligators. The electric eel is found in the lakes of Caracas. In the marshes and swamps of tropical America the boa-constrictor is found of enormous size. Immense centipedes, scorpions, and spiders also abound in these regions. Ants, termites, and locusts also swarm, the latter to a frightful extent, especially in Buenos Ayres and some of the neighbouring provinces, sometimes covering the ground for a distance of 200 miles, devouring every green thing, even the grass, to the very roots. They enter the houses, and devour every edible thing they contain; even curtains, clothes, and furniture are attacked by them, and much injured, if not rendered wholly useless; and in one night gardens on which much pains and expense have been bestowed, are utterly destroyed by these rapacious creatures. The mosquito is also a grievous infliction in many parts of South America, especially in Venezuela and along the banks of the Orinoco. The chigoe, another much dreaded insect, abounds in the same localities.

Amongst the domesticated native animals of South America are the lama and alpaca, both used as beasts of burden. The horse, ass, ox, sheep, goat, and pig were all conveyed from the Old to the New World, none of them being indigenous to the latter. Horses and cattle, however, have now increased in all parts of America, and roam wild in herds over the southern plains.

**Races of Men.**—There exists a very striking general physical resemblance between the native inhabitants of America throughout the whole of both continents, from Cape Horn to Behring's Straits. They are almost all of a reddish-brown or copper colour, with long black hair, deep-set black eyes, aquiline nose, and often of handsome slender forms. In South America many are half-civilized, but a greater number are in a state of utter barbarism. The Araucanians of Chili are more advanced in civilization than the Indians of the Pampas. They associate in small communities, have fixed residences, cultivate the ground, and subsist chiefly on the produce of their labour. They excel in the art of weaving, and produce an excellent woollen cloth. They are a well-disposed people, have few of the vices of other savages, and possess firmness and courage in a remarkable degree. Like all the other Indians throughout South America, they have been long acquainted with the art of working in metals, especially gold and silver. See ARAUCANIANS.

The Pampas Indians are of a very dark complexion, with long, thick, coarse black hair, which generally hangs loose over their shoulders. Their eyes are black, animated, scowling, and are placed widely apart; foreheads low and broad; faces flatish; high cheek-bones and large jaws; they have no beard, are of rather low stature, and ill made, but muscular and athletic. They are expert horsemen, and can slip round and suspend themselves under their horse's belly when at full speed, merely clinging by their hands and feet, and can regain their seat at pleasure without checking the animal's speed. They are still in a very savage state, subsisting on raw animal flesh and leading the roving life of hunters. They do not cultivate the ground, nor apply themselves to any sort of labour. In manner they are boisterous, and

in disposition cruel and ferocious, settling their disputes with the knife, in the use of which they are singularly expert.

Of the Indians that inhabited Brazil there are said to have been at one time no fewer than 200 distinct tribes. A few of these may be named, and their principal physical and moral characteristics alluded to. The Tapuyas, robust, well made, and copper-coloured; long, sleek, black hair; paint themselves, and pierce the under lip for the purpose of introducing a ring or other ornament; the greater part of them said to have been cannibals. The Tupis or Tupinambas inhabit chiefly the coast from the river Camama to that of San Francisco. They also paint their bodies. The Cafusos, a mixture of Indians and negroes, remarkable for an extraordinary peculiarity in the hair of the head, which rises perpendicularly from the forehead to the height of a foot or a foot and a half, giving them a very strange and disagreeable appearance. The Puris, the most revengeful and vindictive of all the Indian races of Brazil. The Botocudos, another cruel and savage race, inhabiting the territory lying between the Rio Doce and the Rio Pardo. The Indians of Brazil are generally of a short or middle stature, and mostly of a robust broad make. They all paint; complexion darker or lighter copper; skin fine, soft, and shining.

South of lat. 38° s. we have the huge Patagonian. The stature and bulk of this race, however, though still remarkable, have been much exaggerated. Their average height is above 6 feet; heads and features large; hands and feet small; colour, dark copper brown; hair black, lank, and coarse. They lead a nomadic life, living in tents formed of poles and skins, and subsisting on the animals they kill.

*Political Divisions.*—South America now comprises the republics of Colombia, Ecuador, Venezuela, Peru, Bolivia, Chili, Brazil, the Argentine Republic (formerly La Plata, including the territories of Patagonia and Tierra del Fuego), Paraguay, and Uruguay (Banda Oriental); the colonies of British, French, and Dutch Guiana and the Falkland Islands (British). For further details see the separate articles on these states. The area of South America is estimated at 6,960,000 square miles; pop. about 37,500,000.

*Discovery, &c.*—The first discoverer of the continent of South America was Christopher Columbus. On May 30, 1498, Columbus set sail from Spain with a fleet of six vessels on his third voyage, and added the Island of Trinidad to his former discoveries. From thence he proceeded to the mouth of the Orinoco, where he landed, and thus achieved the honour of being the first discoverer of the continent of South America. The adventurer who followed next in the tract of Columbus was Alonso de Ojeda, a young, bold, and enterprising Spanish cavalier, who, inspired by a similar spirit with the great navigator, and partaking in some degree of his genius, fitted out, at his own expense, an expedition of four ships, with which he pursued the course taken by Columbus. Having reached the continent of South America, near the equator, he passed the mouths of the Essequibo and Orinoco, examined the whole coast of Venezuela as far as Cape Vela, and thus ascertained that the land along which he sailed was part of a continent. Ojeda was accompanied in this voyage by Amerigo Vespucci, a native of Florence, an experienced mariner, and a man of considerable talents and acquirements. On the return of the latter to Spain, in the year 1500, he published an account of his voyage. His book was read with all the interest and avidity which its extraordinary disclosures were so well calculated to excite, and the author's name silently but indelibly affixed to the New World.

Brazil was discovered in 1500 by Vincent Yanez Pinzon, who had accompanied Columbus in his first voyage. Steering north he explored the mouths of the Amazon; and noting with amazement the immense body of water which it poured into the ocean, correctly inferred that so mighty a stream could be found only in a continent of great extent. Later in the same year Alvarez Cabral reached the coast of Brazil farther to the south than the point touched by Pinzon, and took possession of the country in the name of the King of Portugal. Towards the close of the year above named Roderigo de Bastidas explored the coast from Cape Vela, the point at which Ojeda's progress terminated, to Puerto del Reterte, where that of Columbus closed, and thus connected the intervening continent. In 1508 Pinzon and Juan Diaz de Solis, an able navigator, were sent out by the Spanish government to explore the west coast of South America. Arriving on the shores of Brazil, beyond which discovery had extended but a little way, they followed the coast towards the south as far as the 40th degree of south latitude. In 1513 Vasco Nuñez de Balboa crossed the Isthmus of Darien, and discovered the Pacific Ocean, but his discovery was not immediately followed up. Reports of rich countries in the south were from time to time received, however, and in 1531 Pizarro, who had sailed with Ojeda, embarked at Panamá with a small force, and made himself master of Peru. Almagro, a companion of Pizarro, pushed southwards into Chili, and in 1537 the country between Darien and Peru was traversed by Vadillo, and Quito was soon after taken possession of by the Spaniards. In 1540 Gonzales, the brother of the great Pizarro, made an exploration across the Andes and came upon the Amazons, down which he sent one of his officers, named Orellana, in search of provisions. Orellana continued his voyage, and though he had only a frail bark to trust to descended this mighty stream to the ocean. In the meantime other discoveries had been made—Juan de Solis having discovered the La Plata in 1515, and Fernando Magalhaens, or Magellan, having sailed along the south-east coast and through the strait that bears his name into the Pacific (1520). De Solis was killed by the natives of the La Plata shores; while Magellan, having sailed across the Pacific, fell in a contest with the natives of the Philippines. In 1526 Sebastian Cabot ascended the Paraná and Paraguay, and established two or three forts. In 1536 the city of Buenos Ayres was built, and next year Juan de Ayolas traversed South America from this quarter to Peru. The main features of the continent were now known with tolerable accuracy. The discoveries of the Spanish and Portuguese gave the possession of almost the whole of South America to these nations—Portugal holding Brazil, while Spain held the remainder. Spanish America, including the viceroyalty of Mexico, or New Spain, and the captain-generalship of Guatemala, had an area of nearly 5,000,000 square miles, and a population of about 17,000,000. Until 1810 the legislative power for all this immense extent of territory was exercised by the high-council of India, as it was called, which had its seat in Madrid, while the executive power was in the hands of the sovereign's representatives in America, namely, four viceroys and five captains-general. In South America were the viceroyalty of New Granada (before 1718 a captain-generalship), the captain-generalship of Caracas, the viceroyalty of Peru, the captain-generalship of Chili, the viceroyalty of Buenos Ayres or Rio de la Plata, which comprised the governments of Buenos Ayres, Las Charcas or Potosi, Paraguay, Tucuman, and Tucuo or East Chili. The colonial system of Spain was a highly vicious one, and it is

no wonder the colonies threw off their allegiance to the mother country. None but Spaniards born in Spain were allowed to receive any civil or ecclesiastical appointment in the colonies, and the sole object of the holders of such offices was almost invariably to enrich themselves. Trade was hampered by most impolitic restrictions, Spaniards only being allowed to receive the produce of the colonies, while Spanish goods alone were allowed to be imported into them. Even intercolonial trade was prohibited. Tobacco was cultivated as a royal monopoly, and the cultivation was mostly in the hands of the Spaniards. Several products of the mother country, such as wine, were not allowed to be produced in the colonies at all, and the establishment of manufactories was prohibited. Taxes and customs were also excessive. The yoke to which the Indians were subjected was particularly oppressive, especially in the mining districts, where they were compelled to work in the mines, agriculture also being forbidden in these regions in order that the Indians might devote themselves exclusively to the—for their masters—more profitable occupation of mining. Attempts at insurrection were made at various times during the second half of the eighteenth century, but in vain; and it was not till Napoleon's conquests threw the affairs of the mother country into confusion that the revolutionary tendencies of the colonies found free vent. In 1810 juntas were formed in Caracas, Buenos Ayres, Chili, and Bogotá, which at first carried on the government in the name of Ferdinand VII.; but in 1811 a declaration of independence was published in Venezuela, and the same year all the colonies declared themselves independent of Spain. The Spaniards attempted to bring them back to their allegiance by force, and a series of struggles took place between the colonial and Spanish troops which lasted till 1824, when the independence of the colonies was finally secured. The Spanish dominions were now divided into the republics of Chili, Peru, Colombia, Argentina, and Paraguay, to which Bolivia and Uruguay were afterwards added. Colombia has since been split up into the separate republics of Venezuela, Ecuador, and New Granada or Colombia. For Portuguese America see BRAZIL.

**SOUTHAMPTON**, a parliamentary and county borough and seaport of England, in Hampshire, beautifully situated on a peninsula at the mouth of the Itchen, near the head of Southampton Water, 71 miles south-west of London. It occupies an acclivity rising gradually from the water, and consists of an old and a new town, the former at an early period surrounded by walls flanked with round towers, of which considerable portions still remain, particularly on the west side. Of the old gates by which the town was at one time entered three are still standing, and bear the names of West Gate, South Gate, and Bar Gate. The last, a remarkable structure, embattled and machicolated, and large enough to contain the guild-hall in the upper part of it, is now, in consequence of the extension of the town, nearly in its centre, and being placed across the principal street, running nearly north and south, divides it into two parts, the part to the north being named Above-bar, and that to the south Below-bar or High Street. The principal street is crossed at right angles by several others, which, in the older quarters, are very irregular, though generally substantial; while those in the more modern portion, Above-bar, present many fine ranges of building. St. Michael's, the oldest of the churches, situated in the west part of the town, is a spacious Norman structure, with a roof supported by light octangular columns and sharply-pointed arches, a large western window with beautiful tracery and upper compart-

ments of richly-stained glass, and a tower terminating in a lofty octagonal spire. There are several other churches possessed of considerable architectural merit. The educational establishments comprise the free grammar-school, Taunton's Trade School, Hartley College, and various other schools; and the literary and scientific wants of the town are supplied by the Polytechnic and Athenæum institutions. The Hartley Institution, established by money left by a Mr. Hartley, contains a magnificent reading-room, library, laboratory, a well-filled museum, and a noble lecture-hall. The charitable endowments include an infirmary, a dispensary, several alms-houses, and God's House Hospital, originally founded as a nunnery, and occupying an antique range of buildings, with a chapel long appropriated to the use of French Protestant refugees. Other buildings and objects deserving of notice are the town-hall, custom-house, municipal buildings, Watts memorial hall, the theatres, philharmonic hall, assembly-rooms, ordnance survey offices, baths, and public parks. About 6 miles from Southampton, and 1 mile from Netley Abbey, is the Royal Victoria Hospital for sick soldiers, standing in about 100 acres of grounds amid beautiful scenery, with accommodation for 1000 men. There are also quarters, distinct from the hospital, arranged to receive 1000 convalescents. A well-organized lunatic asylum forms part of the establishment.

The docks present a very bustling appearance, filled as they generally are with shipping of every class, from the noble vessels of the Royal Mail, the Union-Castle, the North German Lloyd's, and other large companies, down to the small steam-tugs. The first tidal-dock was opened in 1842; other docks have since been constructed, including a graving-dock (750 feet in length), opened in August, 1895. The accommodation thus latterly provided has made Southampton the most important mail-packet station in the kingdom. The total exports from Southampton in 1900 amounted to £12,180,215 in value, fully £2,505,000 of this consisting of foreign and colonial goods re-exported; the imports amounted in value to £13,810,833. Chief among the exports are cotton goods, woollen goods, apparel and haberdashery, machinery, leather, &c. Among imports the chief are butter, meat, wool, skins and hides, coffee, cocoa, grain, vegetables, silk manufactures. The industries or manufactures of Southampton are chiefly confined to brewing, coach-building, iron-casting, sugar-refining, and ship-building.

One of the greatest attractions connected with the town is the Southampton Common, a beautiful tract of land, richly wooded, 365 acres in extent, left to the town for public purposes many centuries ago. On this common is situated the race-course, one of the most picturesque in England. Fifteen acres of the common, in the south-east corner, are now appropriated as a cemetery for the town. The public parks in the centre of the town are well laid out, and contain several monuments of men of local and general note. Southampton claims to be a borough by prescription, but its earliest known charter was granted by Henry II. Since the time of Edward I. it has returned two members to Parliament. The town as regards its name is contrasted with Northampton. Pop. (1891), 82,126; (1901), 104,911.

**SOUTHAMPTON WATER**, an inlet of the sea stretching into the interior of Hampshire for about 11 miles in a north-westerly direction, and debouching into the Solent opposite the Isle of Wight. It receives the rivers Anton, Itchen, and Hamble. The tidal wave being intercepted each way by the Isle of Wight, it has four tides in the twenty-four hours. The port of Southampton is situated near its head; the traffic on the Water is consequently great.

**SOUTH AUSTRALIA.** See **AUSTRALIA (SOUTH).**

**SOUTH CAROLINA.** See **CAROLINA.**

**SOUTHCOTT, JOHANNA**, a singular fanatic, whose extravagant pretensions attracted a numerous band of converts in London and its vicinity, said to have, at one period, amounted to upwards of 100,000. She was born in the west of England, about the year 1750, of parents in very humble life, and, being carried away by a heated imagination, gave herself out as the woman spoken of in the Book of Revelations. In this capacity, although in the highest degree illiterate, she scribbled much unintelligible nonsense, and for a while carried on a lucrative trade in the sale of seals, which were, under certain conditions, to secure the salvation of the purchasers. A disorder subsequently giving her the outward appearance of pregnancy, after she had passed her grand climacteric, she announced herself as the mother of the promised Shiloh, whose birth, she announced, was to take place on the 14th of October, 1814. The faith of her followers, among whom were several clergymen of the Established Church, rose to enthusiasm. A cradle of the most expensive materials, and highly decorated, was prepared by her expectant votaries at a fashionable upholsterer's, and every preparation made for the reception of the miraculous babe. The time having passed over without the expected event she declared, that 'if she was deceived she had, at all events, been the sport of some spirit, either good or evil,' and, December 27 in that year, death put an end to her expectations. Her followers, though for a time confounded by her decease, which they could scarcely believe, anticipated her speedy resurrection.

**SOUTHEND-ON-SEA**, a municipal borough and watering-place of England, in Essex, on the estuary of the Thames. It has an iron pier  $1\frac{1}{2}$  mile long, along which an electric tramway runs; a fine esplanade; various churches and chapels; an institute, containing a library; technical schools; parks and public gardens; sea-water baths; &c. It is much frequented by Londoners in the summer months. Pop. (1891), 13,242; (1901), 28,857.

**SOUTHERNWOOD.** See **WORMWOOD.**

**SOUTHEY, ROBERT**, a celebrated English poet and prolific miscellaneous writer, was the son of a linen-draper at Bristol, where he was born 12th August, 1774. After receiving the elements of education in his native town he was sent to Westminster School in 1788, and soon gave proof of distinguished talents. He was dismissed from Westminster in 1792 for a satirical paper on flogging published in a school journal, *The Flagellant*, and shortly afterwards entered Balliol College, Oxford, with the view of studying for the church. For this, however, the ultra-liberal opinions which he had formed, both in religion and politics, were very ill adapted, and he turned his attention to medicine, but soon gave it up in disgust. He left Oxford in 1794, and having formed an acquaintance with Coleridge, they were married on the same day to two sisters, in 1795. They had formed, with Lovell, another brother-in-law, and some others, an enthusiastic scheme to go out to the wilds of North America and form what they meant to call a Pantisocracy, in which, by excluding all the social disorders of the Old World, they were to revive the golden age. This quixotic scheme was abandoned for want of means, and Southey, after selling his *Joan of Arc* for £50, sailed for Portugal with his uncle, a clergyman, who had brought him up, and who had obtained the appointment of chaplain to the English factory at Lisbon. After his return to England he in 1798 entered Gray's Inn, with the view of studying law, but never made any progress in it, and this concluded his final trial of all

the three learned professions. He again visited the Peninsula in 1801, and after his return became, for some time, secretary to the Irish chancellor of the exchequer. Previous to this time he had published several poems, including a violent democratical piece entitled *Wat Tyler*, which was afterwards destined to obtain a notoriety, for which the author felt anything but thankful. He had now renounced his democratical opinions, and gone rapidly into what many considered an opposite extreme. His first poem which attracted much notice was *Thalaba the Destroyer*, a metrical romance, in two vols. 12mo, published in 1802. In 1804 he fixed his permanent residence at Greta, near Keswick, in the heart of the English lake district. Wordsworth had preceded and Coleridge soon joined him. The poetical union thus formed appears to have suggested the idea of regarding them as the heads of a new school of poetry, to which was given somewhat sarcastically, though not inappropriately, the name of the Lake School. From this period his intellectual activity was untiring, and he continued for a period of almost forty years to issue annually at least one, and often several, works in verse and prose, besides contributing largely to different periodicals. His first wife, who had suffered for some years from mental derangement, died on 16th November, 1837; and on 5th June, 1839, he married Caroline Anne Bowles. He soon after sank into a state of mental imbecility, and died 21st March, 1843. In 1807 Southey received a pension from government, in 1813 he was appointed post-laureate. The University of Oxford conferred on him the degree of LL.D. in 1821, and in 1835 he received an augmentation of his pension. He paid several visits to the Continent besides those we have referred to. His works are so numerous that even a bare list of them would occupy a large space. Among his poetical productions may be mentioned—*Joan of Arc*; *Thalaba*; *Madoc*; *The Curse of Kehama*; *Roderick, the last of the Goths*; a *Poet's Pilgrimage to Waterloo*; and a *Vision of Judgment*. Not one of these is without beautiful and magnificent passages, but they are imbedded among much of a very inferior description, and not unfrequently not more deficient in good taste than virulent in spirit. He appears to greatest advantage in several of his minor pieces, on which, as a poet, his fame will in all probability ultimately rest. His prose works are remarkable for the beauties of their style, which for simplicity, facility, purity, and perspicuity, have seldom if ever been surpassed. Among others may be mentioned his *Life of Nelson*, which is almost a perfect model of its kind; *Life of Wesley*; *History of Brazil*; *Sir Thomas More, or Colloquies on the Progress and Prospects of Society*; *The Book of the Church*; and the *Doctor*. The contrast furnished by his political sentiments in early and in later life furnished his opponents with a handle of which they did not scruple to avail themselves. There is a life of Southey by his son published along with his correspondence in six vols. 8vo, 1849–50. His poetical works, collected by himself, were published in 1837–38, and reissued in ten vols. 1850.

**SOUTH MOLTON**, a municipal borough of England, in Devonshire, 24 miles N.N.E. of Exeter, with manufactures of shirts, collars, and leather. Pop. (1891), 3082; (1901), 2848.

**SOUTH POLAR EXPEDITIONS.** Antarctic expeditions have been fewer in number than Arctic ones, and have excited less general interest, partly because the Antarctic region is more remote from the centres of civilized enterprise than the opposite polar region, partly because a stronger mercantile motive stimulated to the latter enterprise than to the former. The discovery of a north-west passage from the

Atlantic to the Pacific was the original object of pursuit in the one case, the more problematical theory of a southern continent furnished the first motive for exploration in the other. The report of a southern continent has been traced back to the sixteenth century. Juan Fernandez sailed from Chili on a w.s.w. course in 1567, and was reported to have reached a *terra firma* inhabited by civilized white people with woven garments. The first discovery of land in the proximity of the Antarctic circle had shortly before this been made accidentally. In 1559 Dirk Cherrits, a Dutch navigator, in endeavouring to enter Magellan's Straits, got separated from his fleet and was driven southward to lat. 64°, where he discovered the South Shetland Islands. The first who undertook a formal expedition in search of the *Terra Australis* was Pedro Fernando de Quiros. His voyage was made in 1605-1606, and resulted in the discovery of the New Hebrides, Pitcairn's Island, and other groups, and of the strait between Australia and New Guinea, known as Torres' Strait, from Luis Vaes de Torres, one of the commanders of the expedition, who sailed through it with two vessels. Captain Cook, whose voyage in 1772-74 was undertaken to test the accuracy of the theory of a southern continent, is the first who is known to have entered the Antarctic circle. Sailing on the parallel of 60° s. lat. he discovered no land to the south of Sandwich Land. He only crossed the Antarctic circle three times for short distances at 40° e. lon., 100°-110° w., and 135°-148° w. He reached the southernmost point attained by him on 30th January, 1774, in 71° 10' s. and 107° w. The voyage resulted in no important discovery within the Antarctic region. In 1821 the Russian Bellinghausen discovered Peter the Great and Alexander Islands. In 1823 Weddell reached lat. 74° 15' in lon. 30° to 40° w. without discovering land. Enderby Land, about lon. 45° to 50° e., and Kemp Land, about 10° farther e., were discovered by Biscoe in 1831-33. The first of these is the easternmost point of the supposed continuous coast, and lies in lat. about 67° 30'. Sabrina Land and Balleny Islands, the former in lon. 117° e., the latter in lon. 163 e., were discovered in nearly the same latitude by Balleny in 1839. In 1840 two important exploring expeditions, the one French, the other American, reached the southern seas. The French expedition, under Dumont d'Urville, found traces of what they believed to be a continuous coast from 136° to 142° e., to which they gave the name of Adélie Land. The explorations of the American expedition under Wilkes were more extensive and important. Captain Wilkes passed very near the southern magnetic pole, the position of which at the time he calculated to be lat. 70° s., lon. 140° e. An ice barrier from 8 to 12 miles deep prevented the expedition from effecting any landing, but it traced land from lon. 154° 27' to 97° 30' e., which, partly from observation and partly from reasoning, Wilkes concluded to be continuous. An expedition sailed from England in 1839 under James Clark Ross, who was knighted on his return. He passed the Antarctic circle about lon. 178° e., and found land in 172° 36' e. lon. and 70° 41' s. lat. He found here a continuous coast trending south, and with mountain peaks 9000 to 12,000 feet in height. He landed on 12th January, 1841, and took possession of the country, which he named South Victoria Land, in the name of the queen. In 77° 32' s. lat., 167° e. lon., he discovered an active volcano, 12,400 feet above the level of the sea, which he named Mount Erebus. Farther east he found an extinct volcano, which he called Mount Terror. At 78° 4' s. he was arrested by a perpendicular barrier of ice 150 feet in height, along which he sailed east

to lon. 168° 37' w. In the following year he was stopped by the barrier in lat. 78° 11' s., lon. 161° 27' w., the southernmost point reached till Borchgrevink attained lat. 78° 50' in 1900. There has recently been a great revival of interest in Antarctic exploration, and several expeditions set sail in 1901. The British expedition in the *Discovery* was promoted by the Royal and Royal Geographical Societies, and received a certain amount of financial and other support from the Treasury and Admiralty. The ship was specially designed for the work, and built at Dundee, and she had on board a staff of scientific experts and a complete set of scientific apparatus. She went by way of Cape Town to New Zealand, and finally set sail from Lyttelton for the Antarctic regions, her objective being the Victoria and Ross quadrants, from 90° e. to 90° w. longitude. The *Morning* was sent to follow up the *Discovery* in 1902. The German expedition in the *Gauss* is entirely a government undertaking, and is in some ways more elaborately equipped than the British one. Its sphere of exploration is the Enderby quadrant, from 0° to 90° e. The Swedish expedition in the *Antarctic* set out to explore the Weddell quadrant, from 0° to 90° w. A Scottish expedition is intended to co-operate with the Swedish one ultimately.

The southern polar region is much colder than the northern. The line of perpetual snow is about 17° farther from the pole than in the Arctic region. Visitors to this desolate region have been rarely able to effect a landing on account of the vast barriers of ice with which the shores seem everywhere bound. The only mammals found in the south polar region are seals and cetaceans. Innumerable penguins frequent the islands. No plants except lichens and algae have been found farther south than Cockburn Island in the South Shetland group. It is an island of about a square mile in area, and rising to a height of 2760 feet above the sea, in lat. 64° 12' s. Vegetation has been found to a height of 1400 feet. Its flora includes nineteen species, several of them only found here, and all belonging to the mosses, algae, and lichens.

**SOUTHPORT** (formerly *South Haves*), a fashionable watering-place on the north-west coast of England, in Lancashire, standing on an extensive open bay near the estuary of the Ribble, 18½ miles by rail north of Liverpool and 37½ miles w.n.w. of Manchester. The level sands extend along the coast as far as Liverpool. The streets are broad and elegantly built. The principal is Lord Street, running parallel with the beach. It is 1 mile long and 90 feet broad, and terminates in a beautiful public park. The houses are in the villa style, with gardens in front. The places of worship are handsome and commodious; there are nearly 200 public and private schools, an institution for the education of Wesleyan ministers' daughters, botanic gardens with fine conservatories and museum. There is a town-hall; the Cambridge Hall, a commodious building capable of holding about two thousand people; a spacious market for meat, flesh, vegetables, a corn, hay and straw market, a convalescent hospital, and an infirmary. Among the greatest attractions of the town are the Pavilion and Winter Gardens, which include a concert-hall, an opera-house, &c.; the artificial marine lake, with gardens and drive; the Free Library and Fine Art Gallery with newsrooms; the Victoria Baths, said to be the largest and most complete in the kingdom; an extensive beach, with tramways, promenades, pavilion, and pier 1480 yards long. Pop. in 1891, 43,026; in 1901, 48,087.

**SOUTHSEA.** See **PORTSMOUTH.**

**SOUTH SEA BUBBLE** is the name by which is generally known a vast enterprise undertaken in

the reign of George I., in which were exhibited, on the part both of the government and people of England, extreme ignorance of the laws of commerce, economy, and finance, combined with much unscrupulousness as to the means of making gain.

The South Sea Company was incorporated by act 9 Anne, cap. xxi. (1711). Harley incorporated the company with a view to take up a floating debt of nearly ten millions sterling. It was to receive interest on it at the rate of 6 per cent per annum, and to obtain a monopoly of the trade with the Spanish settlements of South America. This arrangement was in accordance with the financial notions of the day. It did not occur to the government that by giving the company, besides interest on the money advanced by them, exclusive privileges for a trade which was to be carried on on the credit of the very money lent by them to government, the country was actually taxed for the debt twice over—once by the government, and a second time, and more severely, by the company. The hopes of the company as to trade were somewhat damped by the Peace of Utrecht. The King of Spain granted to the English the right of supplying the South American colonies with negroes for thirty years, but only allowed one ship a year to be sent for general cargo, of the profits of which the king was to have one-third. Even these terms were violated by Alberoni, whose policy soon led to another rupture between the kingdoms. The only ship ever sent sailed in 1717. This terminates the first and more sober part of the company's history. The second opens, publicly at least, in 1720. At the beginning of this year the company, after communication with the government, made a proposal in Parliament to take up a further portion of the national debt. There was a charge on the revenue of £800,000 for irredeemable annuities created in the reign of William III. This was the fund on which the company proposed to operate. Parliament adopted the plan of the company, but decided that it should be thrown open to competition. The Bank of England entered into the competition, and the South Sea Company finally offered a premium in their own stock of £7,567,000 sterling for the right to buy up the annuities. Thus, a company without business proposed to increase its capital by making a loan to government, and on the basis of a saving of interest on a revenue of £800,000 offered a premium of £7,567,000. Walpole published a pamphlet condemning this scheme as unsound, both financially and constitutionally, but the eagerness on all sides to invest in it was immense. The annuitants, though not compelled to sell, rushed to exchange their annuities for stock in the company, which was sold to them at a rapidly-rising premium; and the general public were equally eager to purchase shares at advancing prices, so that, after the 24th August, when a fourth new subscription was opened, the shares reached a culminating price of over £1000 for the £100 shares. In promoting this result the directors had not been idle. All kinds of false rumours were spread, and a dividend of 50 per cent promised after Christmas.

The collapse of the company was as sudden as its rise, and the touch which burst the bubble was given by its promoters themselves. The mercantile prosperity of the country and the deficiency of banking facilities had produced throughout the country a considerable accumulation of capital in private hoards. A demand for investments had consequently arisen, and an era of joint-stock companies had set in. This tendency was stimulated to an extravagant excess by the success of the South Sea Company. Every kind of shares rose rapidly in price, and new companies were starting into existence daily, until the nominal

capital at current prices of the various joint-stock companies of the kingdom was estimated at £500,000,000. It was plain to the directors of the South Sea Company that such a general inflation could not last. The only chance to save their own scheme was to crush their rivals. They applied to government, and procured a proclamation against companies organized without legal authority, and prosecutions were begun against several companies and threatened against all others. In the panic produced by these proceedings all the inflated stocks began to decline. Those of the South Sea Company shared in the movement, and soon became the most prominent object in it. By 29th September they had fallen to £75. The rage of the public, deceived by its own greed, now became boundless, and demands became loud for the punishment of the directors. Walpole was intrusted with the task of guiding the country through the crisis. He had opposed the scheme, but did not disdain to profit by the public mania for it. He had speculated in the stock of the company, sold out at £1000, and expressed himself perfectly satisfied—a feeling which was probably not shared by the buyers.

The measures taken by Walpole were to confiscate the private estates of the directors, which amounted to £2,000,000, to maintain the public obligations to the company and engraft part of its stock on the Bank of England and on the East India Company. A bill for carrying out the latter process passed in 1720, but before it took effect it was partly superseded by another, passed in 1721 remitting £5,000,000 of the sum which the directors had agreed to pay the public. The rest of the sum was remitted two years later. It was found that the company had issued £500,000 of fictitious stock, which had been largely used for bribes to secure the passage of their bill. Members of government and ladies of the court were implicated, and the king himself was suspected of receiving a gratification. The cashier fled, and the books were found to be full of entries in fictitious names, blanks, erasures, and alterations. The directors were also accused of selling their private shares at large premiums while buying in on behalf of the government. Aislabie, the chancellor of the exchequer, was expelled the House of Commons and committed to the Tower; and the Earl of Sunderland, the first lord of the treasury, though acquitted, was compelled to resign. The trading privileges of the company were withdrawn by 47 George III. cap. xxiii., and certain duties were appropriated to form a fund for its indemnification. By these means a dividend of £33, 6s. 8d. on the £100 shares was eventually paid to the shareholders.

**SOUTH SEA ISLANDS.** See **POLYNESIA**.

**SOUTHWELL**, a town of England, in the county of Nottingham, 14 miles north-east of Nottingham, giving name to a diocese comprising the counties of Notts and Derbyshire, the first bishop of which was appointed in 1884. Its cathedral (formerly parish church) was founded in the seventh century, and is a magnificent edifice with three great towers, these and the nave and transepts being Norman, the choir and aisles Early English, and the chapter-house Decorated. The choir and the chapter-house are very fine examples of their respective styles. The church was restored in 1882. The Saracen's Head Inn (probably a fourteenth-century house) is full of historical interest. Here Charles I. gave himself up to the Scotch commissioners. The ancient palace of the Archbishops of York, now in ruins, is situated near the cathedral. Pop. (1891), 2881; (1901), 3160.

**SOVEREIGN**, in politics, the highest person in a state; applied also adjectivally to the highest power in a state, or to a state which exercises supreme or independent authority. Thus the legislature in its various

branches is the sovereign power in each state, though the name of sovereign in a limited monarchy is reserved for the monarch, and a state which owns no superior is termed a sovereign state.

**SOVEREIGN**, a gold coin, the standard of the English coinage. It exchanges for twenty shillings sterling. The standard weight of a sovereign is 123·2744783306581059 grains. A margin of about  $\frac{1}{2}$  grain is allowed in sovereigns issued as of full weight, a journey weight of 701 sovereigns being used in weighing sovereigns in the mint. By act 33 and 34 Vict. cap. x. sovereigns not defaced nor called in and not weighing less than 122·5 grains are a legal tender to any amount.

**SOWERBY BRIDGE**, a township in the West Riding of Yorkshire, 18 miles s.w. of Leeds, on the Rochdale Canal, with manufactures of cottons, woollens, and carpets, chemical, iron, and other works. Pop. in 1891, 10,408; in 1901, 11,477.

**SOWING and SOWING-MACHINES.** The prerequisites of sowing are the preparation of the soil for the seed and the preparation of the seed for the soil. The soil must be cleaned, tilled, and put in a state most economical of its own resources and most active in appropriating those offered to it through atmospheric influences. The seed must be carefully selected, as it would be an obvious waste of labour and natural resources to sow inferior seed when by any reasonable pains better could be procured. Virgil recommends the careful selection by hand of the largest grain as the only means of counteracting the natural tendency of all things to decay. Healthy and vigorous seed is indispensable, but size is only one indication of these qualities. Virgil also mentions the practice of steeping the seed, and the same practice is mentioned by Columella. In modern practice acid or alkaline steepes are used to destroy bruised and imperfect grains and fungoid spores. Lime-water, putrid urine, or sulphate of soda are the commonest alkaline steepes for grain; sulphate of copper or iron and some arsenical preparations are used as acid steepes.

In sowing it is important to regulate the quantity of seed sown, so that too many plants may not be crowded together without sufficient room for growth, and the distribution, so that the whole ground may be profitably occupied. Theoretically the plants should be equidistant in all directions, but for the purpose of cleaning it is better that they should be planted in rows, leaving the maximum distances between the rows so as to admit of the introduction of fallow instruments. In broadcast sowing much seed is lost by either failing to attain sufficient depth in the soil or falling too deep to shoot. Sowing in rows is therefore more economical both of the seed and of the resources of the soil than sowing broadcast.

All these conditions are studied in the construction of sowing-machines. As a first general principle in all machines the rate of delivery is measured by the revolution of the driving-wheel. Among the simplest and earliest forms of machine is a cylindrical vessel with round holes at regular intervals round its circumference for sowing round seed, such as turnip-seed. The machine is placed on wheels, and drawn over the land at a regulated speed, when by its mere revolution the seed is delivered with tolerable uniformity. In order to make the delivery of seed by such a machine as uniform as possible it is necessary that the quantity of seed in the cylinder should always be uniform, as otherwise a greater number of holes will be covered by the seed, and consequently in process of delivery, at one time than another. In Moodie's turnip-sower the seed is supplied from a reservoir connected with the cylinder at its axis so as to keep

the cylinder always half full. Another class of machines consists of those having a fixed seed-box, the delivery from which is regulated by internal revolving machinery. The holes for delivery are placed at regular intervals near the bottom of one side of the seed-box. The delivery is regulated by a series of short revolving cylinders or cylindrical brushes turned by a common shaft, and one of which covers each hole. When the cylinder is plain its surface is indented with holes or cups at regular intervals in which the seed is contained, and a stiff brush in front sweeps the front of the cylinder as it revolves so that no more than successive cupfuls of seed are delivered. The rate of delivery is regulated by multiplying wheels, by means of which the cylinder may be made to revolve more or less rapidly. The revolving brush is only used for very small seed. The rate of the delivery is regulated by the size of the holes, not being proportionally affected by rapidity of revolution.

One of the best modes of delivery is that adopted in what are called Suffolk drills, in which the delivery is regulated by cups attached to projecting arms on a revolving disk. The cups dip into the seed and lift successive portions, which they deliver at the height of their revolution into a funnel placed for its removal to the ground. A series of disks is moved by a connecting-shaft. The disk may be armed with cups on both sides, and have two exit-holes. The revolutions of the disks, like those of the cylinders in the previous class of machines, are regulated by multiplying wheels. Another mode of delivery is by an oscillating movement given to a false bottom of the seed box. The real and the false bottom are both provided with holes, and when the holes correspond the seed falls. The delivery in these machines is regulated by brushes. Sometimes a rotatory movement of the upper plate or false bottom is adopted instead of a lineal oscillating movement. These machines are liable to cut the seed.

In broadcast machines no special apparatus is needed for conveying the seed to the ground, the intervals of the holes causing it to fall evenly on the ground. In the machines called drills the funnel into which the seed is dropped is designed to convey it accurately into the row in which it is to be sown, the rows being parallel to the course of the machine. For this purpose the funnel terminates in a heavy coulter, which opens a channel of uniform depth for the deposit of the seed, which is then covered by a harrow. The coulters require occasionally to be lifted for the purpose of cleaning or to turn the machine or pass obstacles. For this purpose they are made in successive funnel or cup shaped pieces. The lowest, when it is pulled up, contains all the others, and still leaves the channel open. This arrangement not only permits them to be lifted in turning but gives sufficient flexibility to overcome inequalities in the ground. The shallowness of these successive pieces, which were at first connected by chains, renders them liable to become deranged and spill the seed; lateral gusts of air may also penetrate them and disturb the regularity of delivery. To obviate this inconvenience Mr. Hornsby adopted flexible tubes and Messrs. Garrett gave greater depth to the connecting-tubes. Another mode of accommodation is to dispense with the chains by making each section wider at the bottom so as to catch in the upper part of the under section. By further improvements drop drills and dibbling machines have been contrived, which not only deposit the seed in rows but at regular intervals within the rows. The seed is caught as it descends the funnel by a revolving pinion or cylinder with cells for its systematic delivery. The regular delivery of manure is also secured by these machines.

In combined machines manure and seed are thus delivered together.

**SOW-THISTLE** (*Sonchus*), a genus of plants of the natural order Composite, sub-order Chicoraceae. There are about fifty species, mostly herbaceous, but some forming shrubs or small trees. Some of the first may be considered cosmopolitan, while the woody sorts are almost restricted to the Canaries and the island of Madeira. The form of these plants varies much, and renders their discrimination difficult. The leaves are alternate, pinnatifid or runcinate; the flowers are yellow or blue, clustered in great numbers on the same head, with an imbricated involucre formed of successive rows of bracts, often swollen at the base. The fruit is uniform, without a beak, compressed, with small longitudinal ribs, and often with transverse rows of small tubercles, crowned with a soft sessile plume, very white, formed of many rows of very fine down, joined in bundles at the base. The most common species in Great Britain is the Common Sow-thistle (*Sonchus oleraceus*). It is very abundant as a weed, and is sometimes used on the Continent as a pot-herb. It grows to a height of 2 or 3 feet, with a branching stem and small yellow flowers. The *S. maritimus* grows in the lagunes and saline soils on the borders of the Mediterranean and the ocean, and is remarkable for its fine heads of yellow flowers. The *S. alpinus* forms a tall and fine plant, with fresh and sharply-defined foliage, and large heads of beautiful blue flowers. It is found in the mountains of Scotland as well as in Switzerland.

**SOY**, a dark-coloured sauce prepared by the Chinese from the seeds of a sort of bean (*Dolichos soja*). The plant has an upright and hairy stem, erect bunches of flowers, and pendulous bristly pods, each containing about two seeds. The process of preparing soy consists in boiling the seeds until they become soft, and mixing with them an equal weight of wheat or barley meal coarsely ground. This mixture is fermented, and a certain proportion of salt and water being added, the whole is allowed to stand for two or three months, care being taken to stir it daily; at the end of this time it is ready for use. The seeds are, besides, employed in China and Japan as food. In Japan they are put into soups, and are the most common dish of the country, being frequently eaten three times a day. Soy is chiefly imported from China and Japan. Much of that retailed is adulterated.

**SPA**, a town of Belgium, in the province of Liège, and 16 miles south of the town of Liège. The houses are in general well built, and the streets wide, straight, and clean; and the town possesses several public squares. In the environs are delightful promenades and pleasure-grounds. The chief importance of Spa is due to its warm, effervescent, chalybeate, saline, mineral waters, which are much used by visitants on the spot, and also extensively exported. There are manufactures of fancy articles of wood, tanneries, forges, blast-furnaces, &c. Spa has enjoyed a long celebrity for its medicinal springs, for which it was already famous in the time of Livy. Pop. (1894), 8135.

**SPACE**. The conceptions which we form of space have long been a subject of controversy in philosophy, and it would appear from the manner in which this controversy has been developed, as well as from the relation in which our conceptions of space stand to our other conceptions, that the opinions held on this subject might form a natural basis for a classification of existing systems of philosophy. The possibility of distinguishing actual systems on such a basis might arise either because space had been selected as a representative subject of discussion, or because the difficulties peculiar to the investigation of it, or some special necessity for undertaking the investi-

gation, had brought it into unusual prominence. All of these considerations have probably contributed in making space one of the leading topics of philosophical discussion; but though all our conceptions are not treated with equal fulness, space does not altogether enjoy pre-eminence. Several others, particularly time, number, and causation, hold an analogous position in systems of philosophy. The problem of space belongs especially to modern philosophy; not but that the same fundamental positions were advanced by ancient philosophers as by their most advanced successors, but the development of relations and consequences resulting from these positions is the fruit of modern controversy. The subject itself being simple, the fundamental differences respecting it are few, and the value of the protracted discussions which it has occasioned depends mainly on the various developments which these differences have been instrumental in producing in the systems of philosophy. It would therefore serve little purpose to enumerate the opinions held by various philosophers on the principal subject itself without attending to the place they have given it in their systems—an attempt much too elaborate to be entered upon in detail in this place; we must accordingly limit ourselves to some general remarks regarding space in its physical bearings. By space, in a physical signification, is understood the space occupied by the material world. Two questions are agitated in regard to space in relation to the material universe, the first as to its extent, the second as to its occupation. Is the material world finite or infinite? The only answer that can be returned to this question is that science has discovered no bound to the extension of the cosmical universe, of which our solar system forms a part. With the improvement of instruments the argument from analogy in favour of an inconceivably great extension of the material universe has become constantly stronger, so that what appear mere specks on the field, even of instrumental vision, may be conjectured to expand into new spheres as vast as all that we can take in from our present point of view, and these again may be bounded by regions equally extended. As to the absolute infinitude of material things, however, we have no means, either by actual information or analogy, of forming any opinion regarding it. Pascal insists upon the absolute infinity of extension and divisibility of the material world. Our universe, he holds, when we have exhausted our imagination in conceiving it, is but a particle to the true universe; and our particle, in like manner, is a revolving universe. Pascal's argument is based on the conception of the infinitude of the Creator. Might not an opposite argument be drawn from the finitude of the creature, that is, of the intelligent beings by whom the material world is tenanted, with whose modes of thought it is co-ordinated, and to whose faculties it may be assumed in some measure to be accommodated?

The question as to the occupation of space by material things turns upon the continuity or noncontinuity of the ultimate particles of matter. This is a question of nearly, if not quite, as great difficulty as that of the extent of the universe. The distinct material forms which are directly recognizable by our senses, the solids, fluids, and gases which we see, feel, taste, or smell—are known to be composed of particles which are kept by certain forces apart from each other. But there are material forces, such as heat, light, and electricity, which are either forces regulative of the atomic structure of matter, or are in other ways related to it, which imply the existence of material media too delicate to come directly within the cognizance of our senses. These forces are forces of motion; and as heat and light are known to travel

through spaces, such as those from the sun and stars to the earth, which contain no atmosphere or other sensible form of matter, these spaces are supposed to be filled with an *ether* or subtle fluid, by the vibrations of which this motion is communicated. The ether is supposed by some to be a continuation of the atmosphere in a state of extreme rarefaction, produced by distance from solid attracting bodies; by others to be a subtle fluid pervading all space, and penetrating in different degrees, according to their structure, the grosser atomic bodies.

SPAGNOLETTO, a celebrated painter, whose true name was Joseph Ribera, or Ribeira, was born at Xativa, in Valencia, 12th January, 1588, but educated at Naples, and probably takes the name by which he is usually known from the country of his birth. He was at first a pupil of Caravaggio, but afterwards improved himself by the study of the works of Raphael and Correggio, at Rome and Parma. After his return to Naples he was appointed court painter to the viceroy, the Duke of Ossuna, and overseer of all the royal works, in which post he conducted himself with great haughtiness towards the artists, and is said to have shown a particular jealousy of Domenichino. It has been said that Ribeira concealed himself, out of chagrin, occasioned by an amour of Don John of Austria, natural son of Philip IV., with one of his daughters, and that nothing more was heard of him; but according to Bermudez he died in good circumstances, at Naples, in 1656. Ribeira excelled in the representation of terrible scenes, such, for example, as the slaying of St. Bartholomew. He executed such subjects with a minute accuracy that excites horror, and was very skilful in delineating the separate parts of the body—hair, wrinkles, skin, &c. There are works of his in Naples, Paris, Vienna, and Dresden.

SPAGNUOLO. See CRESPI.

SPAHIS, or SIPAHIS, the name formerly given to a part of the Turkish cavalry, which is said to have been organized by Amurath I., the founder of the janizaries (see JANIZARIES); but which, since the organization of the Turkish army on the European system has given place to regular cavalry. The spahis were composed of two classes: one with red, the other with yellow banners. The usual arms of the spahis were a sabre, a lance, a jereed (a dart about 2 feet long, which was hurled with great strength and skill), and a second sabre, or rather broad-sword, attached to the saddle. Some of them had bows and arrows, and also pistols and carbines; but they made little use of fire-arms. The French call a body of light cavalry raised in Algeria by the name of spahis. The name sepoys given to our native troops in India is the same word.

SPAIN (Spanish, *España*), a state in the south-west of Europe, forming the far greater part of the Spanish Peninsula, and including the Balearic and the Canary Islands. Exclusive of these islands it lies between lat. 36° and 43° 46' N.; lon. 9° 10' and 3° 15' W. It is connected with the Continent on the north-east by the chain of the Pyrenees separating it from France; and is bounded east and south by the Mediterranean Sea, west by Portugal and the Atlantic Ocean, and north-west by the Bay of Biscay. Measured diagonally, the greatest length is from Cape Creux in the north-east to Cadiz in the south-west, 656 miles; greatest breadth, from Cape Ortegal in the north-west to Cape Palos in the south-east, 583 miles; but measured due north and south and due east and west the greatest length is from Cape Penas to Tarifa, 540 miles; and the greatest breadth from Cape Creux to Cape Hombro, Vigo Bay, 620 miles. Of her once magnificent possessions in Asia, Africa, America, and Polynesia, Spain retains al-

most nothing. Cuba and Porto Rico, two of the most valuable islands in the West Indies, were lost by her as a result of the recent war with the United States. The Philippine Islands off the coast of Asia were also ceded to that power on the conclusion of the war. About the same time Guam, one of the Ladrões, was transferred to the United States, and soon afterwards the other islands of the group, together with the Carolines, were sold to Germany. She still possesses some territory in north and north-west Africa, besides the islands of Fernando Po, Annabon, &c., off the west African coast. The following table gives the area and population of the whole kingdom, showing both the ancient kingdoms and provinces, and the modern provinces:—

Ancient Kingdoms and Provinces.	Modern Provinces.	Area in sq. miles.	Population in 1867.
New Castile.....	Madrid.....	2,907 ..	787,444
	Toledo.....	5,586 ..	870,012
	Guadalajara.....	4,870 ..	199,290
	Cuenca.....	6,725 ..	241,566
	Ciudad-Real.....	7,840 ..	305,002
Old Castile.....	Burgos.....	5,650 ..	340,001
	Logroño.....	1,945 ..	186,223
	Santander.....	2,113 ..	263,673
	Soria.....	8,838 ..	147,787
	Segovia.....	2,714 ..	156,086
Leon.....	Avila.....	2,981 ..	197,636
	Palencia.....	3,128 ..	198,698
	Valladolid.....	8,043 ..	276,896
	Leon.....	6,107 ..	384,197
	Zamora.....	4,135 ..	275,854
Asturias.....	Salamanca.....	4,940 ..	317,006
	Oviedo.....	4,091 ..	612,663
Galicia.....	Coruña.....	3,079 ..	631,419
	Lugo.....	3,787 ..	459,119
	Orense.....	2,759 ..	402,873
Extremadura.....	Pontevedra.....	1,739 ..	447,612
	Badajoz.....	8,887 ..	490,551
	Caceres.....	8,013 ..	354,245
	Seville.....	5,295 ..	547,020
	Cadiz.....	2,809 ..	434,250
Andalusia.....	Huelva.....	4,122 ..	253,970
	Cordova.....	5,190 ..	443,582
	Jaén.....	5,184 ..	463,806
	Granada.....	4,937 ..	477,768
	Almería.....	3,302 ..	344,681
Aragon.....	Malaga.....	2,824 ..	485,132
	Saragossa.....	6,607 ..	413,480
	Huesca.....	5,878 ..	238,985
	Teruel.....	5,491 ..	239,831
	Murcia.....	4,478 ..	518,263
Murcia.....	Albacete.....	5,972 ..	233,005
	Valencia.....	4,352 ..	775,995
	Alicante.....	2,098 ..	451,174
Valencia.....	Castellon.....	2,446 ..	304,477
	Barcelona.....	2,985 ..	1,084,538
	Tarragona.....	2,451 ..	334,343
Catalonia.....	Lerida.....	4,775 ..	274,867
	Gerona.....	2,272 ..	298,497
Navarre.....	Navarre.....	4,055 ..	302,978
	Biscay.....	849 ..	230,222
Basque Provinces.....	Gulpuzcoa.....	728 ..	191,822
	Alava.....	1,205 ..	94,622
Islands.....	Balearic.....	1,860 ..	306,926
	Canaries.....	2,808 ..	334,521
Total.....		197,766	18,078,497
African Possessions.....		243,890	147,000
Grand total.....		441,656	18,225,497

*Physical Features.*—The coast line is not much broken, but sweeps round in gentle curves, presenting few remarkable headlands or indentations. The interior is as much diversified as that of any other country of the same extent in Europe, but its characteristic feature is its centre table-land, which occupies more than a half of the whole surface, and is from 2000 to 3000 feet above sea-level. It is nearly surrounded by mountains; north by those of the Asturias, an obvious continuation of the Pyrenees, west by a branch of the same mountains stretching southward through Galicia, and along the frontiers of Portugal to the banks of the Douro, and thence continued through the south of Leon and Estremadura by a series of cordilleras, which finally become

linked with a branch of the Sierra Morena; south by the Sierra Morena; south-east and east by the mountains of Murcia and Aragon, among which the sierras Albaracin and Molina are the most conspicuous; and north-east by a range which, commencing in the Sierra Moncayo, stretches north-west through Old Castile, and there forms the southern boundary of the basin of the Ebro. The table-land itself is traversed throughout its whole breadth, east to west, by two mountain-ranges. The loftier of the two, the Sierra de Guadarrama, divides the table-land into two distinct portions; a northern comprehending the kingdoms of Old Castile and Leon, and covering an area of about 44,000 square miles, and a southern comprehending the kingdoms of New Castile and Extremadura, and covering an area of about 48,000 square miles. The second great range of the table-land lies wholly within the latter, and commencing in the Sierra Albaracin, on the confines of Aragon, stretches under various names, among which those of the sierras of Guadalupe, Toledo, and Mamez, are most conspicuous, nearly across the centres of New Castile and Extremadura, till it is met by the Sierra Alpedrena from Portugal. Besides these mountain ranges which thus bound or traverse the table-land, there is the magnificent chain of the Pyrenees, which, though partly belonging to France, presents its boldest front to Spain, and has its loftiest summits within it; and the Sierra Nevada, which, with its ramifications, covers the greater part of the south of Andalusia. The rivers are numerous, and several of them pursue courses of several hundred miles, draining large tracts of country. Their general direction is that of the great mountain ranges, flowing either eastward or westward. Those which flow eastward belong to the basin of the Mediterranean, and those which flow west to that of the Atlantic. The most important rivers of the former basin are the Ebro, the Segura, which rises in the most western part of Murcia, in the sierra of same name, and has an easterly course of at least 200 miles; the Jucar, which, rising between the sierras Molina and Albaracin, flows for the most part through a wide and fertile valley, upwards of 200 miles; and the Guadalquivir, which has a course of about 150 miles. The most important rivers of the latter basin are the Douro and Tagus, which, however, are more Portuguese than Spanish rivers; the Minho and Guadiana, also partly shared by Portugal; and the Guadalquivir. Considering the number and height of the mountain ranges, it is remarkable that Spain does not possess a single mountain-lake deserving of notice. Its only expanses of standing-water are the lagoons which line part of its southern and western coasts, and are not only devoid of beauty, but often poison the air with pestilential vapours.

*Geology and Minerals.*—Almost all the mountain-ranges have a nucleus of granite, overlain by crystalline schists. This is particularly the case in the Pyrenees, the mountains which separate the two Castiles, and the basins of the Douro and Tagus, the Sierra Morena, and the Sierra Nevada. In the last the granite and schists often give place to immense masses of serpentine. The mountains of Asturias consist almost entirely of carboniferous limestone and sandstone; and the same formation is largely developed in the Sierra de Gador, and in the deep valleys of the Alpujarras. Secondary rocks, still higher in the series, consisting of chalk and the accompanying strata, often overlie those of the carboniferous limestone, and have their largest development in the districts which border the east coast. They also form great part of the ridges which intervene between the plain of La Mancha and the Mediterranean. Tertiary formations are found partly on

the higher table-land in Old Castile, where they consist chiefly of marls and gypsum, and partly on the plains of Valencia, Alicante, Murcia, Cartagena, Aguilar, and Granada. They also fill several valleys, among others, those of the Segura, Lorca, Lower Ebro, and Guadalquivir. The whole country teems with mineral wealth, the minerals including in greater or less quantities gold, silver, quicksilver, lead, copper, iron, zinc, calamine, antimony, tin, coal, &c. In the north (Asturias and Galicia) there are inexhaustible masses of iron ore. This ore is largely imported into Britain, and being very free from phosphorus and sulphur, is excellently adapted to the Bessemer process. Iron is also abundant in the Basque provinces. On the north coast there are important zinc mines. Lead is found in great abundance in the form of galena, the principal centres of production being Linares, Cartagena, and Almeria. About 100,000 tons of pig-lead are annually produced. In the province of Huelva, in the south of Spain, are immense deposits of iron pyrites, owned principally by English companies. The principal mines are the Rio Tinto and the Tharsia, the latter exporting annually 250,000 tons of pyrites. The ore contains 47 per cent. of sulphur and  $1\frac{1}{2}$  to  $2\frac{1}{2}$  per cent. of copper, both of which are extracted to profit in Great Britain. Coal exists in various districts, but is chiefly obtained in the Asturias and Leon. The crown formerly possessed valuable mineral deposits, but has alienated the most of them except the quicksilver mines of Almaden.

*Climate.*—This, owing to the physical configuration of the surface, varies much in different localities. On the elevated table-land it is both colder in winter and hotter in summer than usual under the same latitude. In Madrid, which is situated upon it, the mean temperature of winter is about 47°, of spring 65°, of summer 86°, and of autumn about 66°. In the hottest month the mean temperature sometimes rises above 89°, and in the coldest falls below 40°. The mean annual temperature is between 65° and 66°. On the table-land, in summer, the sky is generally clear and cloudless, and rain seldom falls, but in winter it both rains and snows frequently. On the north coast the climate is damp, and injury is often suffered from a superabundance of moisture. In the north-west, in Galicia, a piercing wind, which the Castilians call *gallego*, often blows. In these quarters, in severe and rainy winters, the cold is occasionally extreme, and the olive and other southern fruits cannot be successfully grown. In the south-east districts, particularly in Murcia and Valencia, a kind of perpetual spring prevails; on the contrary, in the south and south-west, in Granada, and other parts of Andalusia, the climate is almost African, and a wind called *solano*, which withers up vegetation and enervates the animal frame, often blows for two weeks in succession. In the west the climate is mild but variable, the summer, however, is often very hot. Snow is confined chiefly to the more mountainous districts.

*Vegetation, Agriculture, &c.*—The mountains and many tracts of the table-land are in general very scantily supplied with trees, and a want of timber, both for fuel and economical purposes, is severely felt in many quarters. The finest forests are on the western offsets of the Pyrenees and in the mountains of Asturias. The more remarkable trees are the Spanish chestnut and several varieties of oak, and in particular the cork-oak. Fruits are extremely abundant, and include, in addition to apples, pears, cherries, plums, peaches, and apricots, the almond, date, fig, orange, citron, and pomegranate; and in the lower districts of the south, the pine-apple and banana. The culture of the vine is general, and

great quantities of wine are made, both for home consumption and exportation. The demand for the latter is chiefly confined to sherry and the sweet wines of Malaga and Alicante. A considerable part of the grapes grown are dried and exported in this state, especially from the port of Malaga. Nuts, common and pistachio, walnuts, and chestnuts grow in such abundance as to form important articles of trade. In the warmer districts the olive, sugar-cane, and cotton-plant are partially cultivated. The extent of land under regular agricultural crops is somewhat limited. Much of the higher part of the central table-land presents a very sterile appearance, having a thin stony soil and a covering of heath and scanty pasture; and even extensive tracts which might be advantageously cultivated are left almost in a state of nature, to be roamed over by cattle, sheep, goats, and swine. The finest agricultural district is Valencia, where both rice and corn are grown far beyond the wants of the actual population, and furnish large supplies to those parts of the interior which are less favourably situated. After Valencia, Catalonia, Murcia, and some of the northern provinces, raise the largest quantities of grain. The more important crops are wheat, rice, maize, barley, and legumes. Hemp and flax are extensively grown in Aragon and Galicia, and esparto grows in abundance, more especially in Valencia and Murcia, where it is in extensive demand for making ropes, mats, baskets, &c., besides being exported. The mulberry thrives well, and is largely cultivated for rearing silk-worms in Valencia, Murcia, and Granada. Other vegetable products are saffron, liquorice, and barilla. It is remarkable that Spain, though one of the most naturally productive, is also one of the least cultivated of the countries of Europe. More than a third of the land capable of profitable cultivation is allowed to lie waste, and the system of agriculture pursued is far behind that of any other European country. The zoology of Spain includes a vast number of species. Of these, however, the only large animals in a wild state are the wolf, common in all the mountainous districts, and the bear and chamois, found chiefly in the Pyrenees. In Biscay the marten is frequently met with, and lynxes, foxes, wild-cats, weasels, &c., are numerous in many quarters. The chameleon is found in the vicinity of Cadiz, and monkeys haunt the rock of Gibraltar. The feathered tribes are very numerous, particularly on the coast and at the mouths of rivers; eagles and vultures are common in some localities, and among interesting birds may be mentioned the flamingo, which is abundant in certain marshy regions of the south, and also breeds there. The number of rivers and great extent of sea-coast give great scope to the fisherman; and some important fisheries are carried on, particularly those of sardines in the north, and of tunnies and anchovies in the south. Among domestic animals the horse, descended from breeds which the Moors had introduced, was long celebrated throughout Europe, but has in recent times declined in reputation, though Andalusia still boasts of many fine animals. The mule is generally preferred to the horse, both for carriage and draught, and is extensively reared in New Castile. Both it and the ass are generally of a very superior description. Horned cattle are generally inferior and not numerous; only in a few districts are cows kept for dairy purposes; bulls, in great demand for the national amusement of bull-fights, are reared in greatest perfection in Andalusia. The favourite stock is the sheep, a considerable proportion of which belong to the celebrated Merino breed, to which almost all the other breeds of Europe are more or less indebted for improvement. Goats also are very numerous, and in their flesh,

milk, and cheese furnish the favourite food of the inhabitants. Swine are kept in large herds in some parts of Estremadura and in some of the northern provinces, where they roam at large in the forests.

*Manufactures Trade, &c.*—In the middle ages the manufactures of Spain, particularly along the coasts of the Mediterranean, were in a flourishing condition, and found an extensive demand, particularly in the Levant and other parts of the East. With the expulsion of the Moors the branches which they had specially fostered sunk rapidly into decay, and have never been revived. New demands, however, arose in the West, and Spain, as the mother country, reserving to herself the sole supply of the colonies, was able, for that purpose alone, to carry on a number of lucrative manufactures. The loss of these colonies, putting a sudden stop to the demand, was followed by their almost as sudden extinction. The circumstances of the country since have been the most unfavourable that can be conceived to the progress of any branch of regular industry, and hence the only manufactures of any importance are to be found in a few of the larger towns, especially Barcelona. Trade labours under great disadvantages from the want of proper means of communication. The roads, except the royal roads (*caminos reales*), are generally wretched; the rivers, though numerous, are ill fitted for navigation; and though in recent times much has been done in constructing railways and tramways, much more is still required. Hence the foreign trade is almost necessarily confined to such articles of raw produce as are raised in greatest abundance and can be most easily conveyed to a seaport. The chief articles of export are wine, fruits, lead, iron ore, copper ore, oils, cottons, cattle, cork, wool, and agricultural produce. In the year 1900 the total imports were of the value of £34,500,000, the exports of the value of £29,000,000. Among the countries sending goods to Spain, Great Britain occupies the chief place, France, the United States, and Germany coming next in order. The exports from Spain to Great Britain in 1900 were valued at £15,882,346, against £6,067,018 in 1870; and the imports of British produce from Great Britain at £5,625,524, against £2,513,177 in 1870. Of the total wine imports into the United Kingdom about two-fifths on an average come from Spain. The length of railways in Spain is over 8000 miles. The merchant marine in 1900 consisted of 1142 vessels (each of 100 tons at least), total tonnage, 541,964 tons; 449 vessels of 430,996 tons burden being steamers.

*Money, Weights, and Measures.*—By a decree of the Cortes in 1868 a new monetary system was introduced into Spain, according to which accounts are kept in *centimos* and *pesetas*: 100 centimos = 1 peseta = 9½d. sterling, or one franc. The gold coins are pieces of 100, 50, 25, 20, 10, and 5 pesetas; the silver coins are pieces of 5, 2, 1 pesetas, and 25 and 20 centimos. The bronze coins are pieces of 10, 5, 2, and 1 centimos. Accounts were formerly kept in *maravedis*, of which 34 = a *real-de-vellon* = about 2½d. sterling. The weights and measures are precisely the same as those of France, with no other change than a slight one of names, the *metre* becoming the *metro*, the *livre* the *liuro*, and so on.

*Government, &c.*—Up to 1868 the government of Spain, which was that of a hereditary constitutional monarchy, was regulated by a constitution adopted in 1837, and subsequently modified in 1845. After the deposition of Isabella II. a new constitution was drawn up by the Cortes, elected by universal suffrage. This constitution bore date 1st June, 1869, and modified considerably the previous one. According to it, 'all powers emanate from the nation. The power to make laws resides in the Cortes. The

sovereign sanctions and promulgates the laws. The executive power resides in the sovereign, who exercises it by means of ministers. The tribunals exercise the judicial power.' After the abdication of King Amadeo in February, 1873, Spain changed its form of government to that of a federative republic, until the proclamation as king of Alfonso XII., December 31, 1874, when the constitution of 1869, was again brought into force. A new constitution, however, was proclaimed in 1876, when certain amendments were introduced. According to the enactments at present in force Spain is governed constitutionally, the executive power residing in the king, the legislative in the king and Cortes (or parliament) conjointly. The Cortes consist of two independent bodies, or bodies of equal authority, the Senate and the Congress. The members of the Senate form three classes, namely, senators in their own right, not to exceed 80 in number; life senators nominated by the crown, 100 in number; and elected senators, 180 in number. The senators in their own right include royal princes who have attained their majority; grantees of the kingdom who are in possession of an income of 60,000 pesetas, or about £2400; captains-general in the army, admirals of the navy; the archbishops, the patriarch of the Indies, the presidents of the council of state, the supreme tribunal, and several other similar functionaries. The elective senators are chosen by the corporations of state, such as provincial legislatures, universities, the ecclesiastical bodies, &c., and the citizens who are the largest payers of state burdens, and this portion of the Senate is renewed by one-half every five years, or altogether when the body is dissolved by the sovereign. The Congress, or second legislative body, is to comprise at least one deputy to each 50,000 of the population. The Cortes must meet each year, and its sessions are to be convoked, suspended, or closed by the king. No project can become law until after it has been voted in both bodies. Projects of finance or taxation must be presented to the Congress before being submitted to the Senate. The various provinces and communes are governed by their own municipal laws with local administration. Every commune has its own elected *ayuntamiento*, consisting of from five to thirty-nine *regidores* or *consejales*, and presided over by the *alcalde*. Each province has its *disputacio provincial* or parliament, whose members are elected by the *ayuntamientos*, and in which are vested large political powers. It meets annually, and is permanently represented by the *consejo provincial*, a committee of its members. The revenue, raised chiefly by direct and indirect taxation, stamp-duties, government monopolies, colonial revenue, and income from state property, amounted, according to the budget of 1901-1902 to £39,000,000, the expenditure being somewhat less. The public debt, consolidated and floating, amounts to over £386,000,000, with an annual interest of nearly £16,000,000.

*Army and Navy.*—The army has been reorganized after the model of that of France. The military forces consist of three bodies—a permanent army, an active reserve, and a sedentary reserve. The permanent army consists of a force which may be annually fixed by the Cortes. All Spaniards above the age of nineteen are liable to be drawn for the permanent army, in which they have to serve three years. The active reserve is composed of all young men who, without reckoning three years of active service, shall have exceeded the number of years fixed by law for the permanent force. The position of these men is that of soldiers upon six months' furlough without pay. The sedentary reserve consists of all those men who, proceeding from the recruits, shall have had three years' effective service.

The term of service in the sedentary reserve is six years. Exemption from service may be purchased for £60. According to a law of 1870, modified by laws in 1877, 1878, 1882, and 1885, the army is recruited by the method of conscription. The kingdom is divided into eight army-corps districts, with headquarters at Madrid, Seville, Valencia, Barcelona, Saragossa, Burgos, Valladolid, and Corunna. The strength of the permanent army for 1900 was returned at 117,774 in peace and over one million in war. The naval force consists of about 14,000 sailors, with about 9000 marines. The navy was almost totally destroyed or captured in the war with the United States, but efforts are being made to recover Spain's position in this respect. At present she has only one battleship, and that of the second class, and very few cruisers, coast-defence vessels, &c.

*Religion and Education.*—The only religion which the state recognizes, and declares itself bound to support, is the Roman Catholic. The church is governed by ten archbishops and fifty-nine bishops, but two of the former and five of the latter have their dioceses beyond sea. The number of parishes is about 21,000. In 1837 all the convents of monks, with a few exceptions, were suppressed, and their revenues, subject to a provision for existing members, confiscated to the state. At the period of extinction the number of convents was 1940, with 30,906 monks; there are still 161 with 1684 monks, and 1027 with 14,592 nuns. In no country has the dominant religion manifested a more intolerant spirit, or been guilty of so many atrocious deeds. But since the last revolution toleration of all denominations has been decreed. The morals of the clergy are said to be too often of a very low type. Until quite recently the mass of the people were sunk in excessive ignorance. Scarcely any of the lower classes could, at the beginning of the nineteenth century, so much as read. Until 1808 public education was entirely in the hands of the clergy, but since then enactments have been passed transferring it to the care of the government, and though little money is granted from the public funds for the purposes of education, government superintendence has effected a very marked improvement. A deplorable amount of ignorance still prevails, however.

*People.*—The inhabitants of Spain consist chiefly of Spaniards proper, composed of a mixture of ancient aborigines, Romans, Visigoths, Vandals, and Suevi; but partly also of three other distinct races—Basques, occupying the provinces to which they give their name, and forming about one twenty-fourth of the whole population; Moors who, in the general expulsion of their countrymen, found refuge in several valleys in the Kingdom of Granada and the Castiles, and whose descendants, unmingled with the other inhabitants, are still living there to the number of about 60,000; and Gitanos, or gipsies, who are found diffused over all parts of the Peninsula. The Spaniards proper, to whom only it is necessary here to advert, are of middle stature, well formed, of a sallow hue, sharp features, dark hair, and keen black eyes. In diet the Spaniards are frugal and temperate. Their wants being thus comparatively few, are easily satisfied, and furnish no strong stimulus to exertion. Indolence accordingly is a prevailing vice, and the highest ambition generally felt is to be able to live without doing anything. In their intercourse with strangers they are reserved, taciturn, and stand much upon their dignity, afraid apparently of its being encroached upon by undue familiarity; but on finding what they conceive to be their true place properly recognized, they lay aside their restraint, form strong attachments, and become the most agreeable of

companions. With their natural indolence there is a strange mixture of enthusiasm, and when their passions are once roused there are few extravagances or excesses of which they are not capable. In favourable circumstances this part of their character has often manifested itself in chivalric exploits; but when accompanied, as it too often is, by ignorance and bigotry, has led to the perpetration of numberless atrocities. In no country has fire and sword been more mercilessly employed in the extirpation of what was called heresy; and until quite recently, under a constitution which professed to guarantee freedom of thought and of the press, no form of dissent from Popery was tolerated. The national character is well pictured in the cruel sport of bull-fighting, cultivated eagerly in every part of the country, and, like horse-racing among the English, established wherever the Spaniard is located.

*History.*—Spain was known to the Greeks and Romans as *Spain*, *Hispania*, and *Iberia*. The most ancient inhabitants of Spain appear to have been the Iberians, who also extended beyond the Pyrenees into Gaul as far as the Rhone. To these afterwards were joined certain tribes of Celts, who succeeded in making a settlement for themselves in the country after sanguinary contests with the aborigines. In process of time the two races were amalgamated into one, and went under the common appellation of Celtiberians. These occupied principally the high table-land in the centre of the country. The other parts were occupied by tribes of Iberians and Celts who had never intermingled. Pure Iberian tribes, from whom are descended the modern Basques, were to be found in the Pyrenees and on the coasts, while the unmixed Celts inhabited the north-western corner of the country, corresponding to modern Galicia. The Phenicians were the first civilized nation who made a descent on the Peninsula, and founded settlements there. Somewhat later the Greeks made their appearance, and, among other colonies, founded Saguntum. But more important than any of these were the colonies established by the Carthaginians. The history of Spain, indeed, only properly begins with the Carthaginian invasion, about B.C. 238. Previous to that almost all that was known of the country was the existence of the two commercial states of Tartessus and Gades, both in the west. The former of these, supposed to have been the Tarshish of Scripture, was much visited by Phenician ships by reason of its mineral wealth. After the first Punic war the Carthaginians began to establish themselves in Spain; large tracts of territory were brought under their sway by Hamilcar (238–229), and again by Hasdrubal (228–221); and among the cities founded by them was New Carthage, the modern Carthage, which soon became a celebrated emporium. The subjected territory extended as far north as the Iberus (Ebro). Pressed by the Carthaginians, the Greek colonies of Saguntum and Emporise applied for aid to the Romans, who already had had their jealousy roused by the successes of their great rival. The Romans interfered, and a treaty was then concluded between the two great powers, in terms of which the Carthaginians bound themselves not to extend their conquests beyond the Iberus. The city of Saguntum was on the west side of the river, but under Roman protection, and the capture of it by Hannibal in 219 was the immediate cause of the second Punic war, which was partly carried on in Spain, and which in 206 caused the total expulsion of the Carthaginians from the Peninsula. The Romans now undertook the subjugation of the entire country, but in this they did not completely succeed until after a war of about 200 years' duration, in which the exploits of the Lusitanian Viri-

athus, the heroic resistance and final downfall of Numantia (133), and the temporary independence of a part of the country under the gallant Sertorius (84–73), form brilliant episodes. The Cantabrians, Asturians, and other tribes in the mountains of the north, were the last to yield, but were finally subjugated by Augustus and his generals, and Spain was converted into a Roman province. Previous to this the Peninsula had been divided by the Romans into two parts, an eastern and a western, separated from each other by the Iberus, called respectively *Hispania Citerior* and *Hispania Ulterior*; but Augustus made a new division of the country, forming it into three provinces—*Tarraconensis*, *Bætica*, and *Lusitania*. *Tarraconensis* and *Lusitania* were erected into imperial provinces, and administered by legates; while *Bætica*, which still remained for a long time a senatorial province, was placed under the authority of a proconsul invested with civil authority only. Until the reign of Antoninus Pius, who granted to all his subjects a uniform constitution and laws, the cities of Spain were ruled by different laws. These and other measures made Spain one of the most flourishing provinces of the empire, and a centre of Roman civilization. Some of the most distinguished Latin writers under the empire were natives of Spain, such as the two Senecas, Lucan, Martial, Quintilian, and others. Christianity was early introduced into Spain, and after the conversion of Constantine the Great became the dominant religion there. The disorganization and confusion consequent upon the fall of the Roman Empire facilitated the conquest of the country by the Vandals, who made themselves masters of a part of Southern Spain, which from them received the name of *Vandalusia* (now Andalusia); the Suevi, who established themselves in the region now known as Galicia; and the Alans, who gained possession of Lusitania, now Portugal. These, however, were soon afterwards attacked by the Visigoths, who, after many years' struggle, succeeded in reducing the whole Peninsula to their sway. The Vandals of Andalusia, unable to withstand them, withdrew into Africa in 428, and from 467 to 484 the great Euric extended the kingdom of the Visigoths by the expulsion of the Romans, and gave them their first written laws; while Leovigild in 585 overthrew the kingdom of the Suevi in Galicia. Under Leovigild's successor, Reccared I., the introduction of the Catholic faith in 586 gave the corrupt Latin language the predominance over the Gothic, and after that time the unity of the Spanish nation was maintained by the Catholic religion and the political influence of the clergy. But after retaining the mastery of the country for nearly two centuries the Visigoths were in their turn conquered by the Arabs or Moors of Africa, who had come across at the invitation of the family of Alaric, the latter being eager to avenge themselves on their countrymen for being passed over in the election of king. King Roderic fell in the seven days' battle against Tarik at Xeres de la Frontera, in Andalusia, in 711. After that the greatest part of Spain became a province of the caliphs of Bagdad.

For some years after their conquest of Spain the Moors held it as a dependency of the province of North Africa; but it was afterwards (717) governed by *emirs* appointed by the caliphs of Damascus. The policy of the Spanish emirs was to extend the Moorish dominion beyond the Pyrenees into Gaul, and the forty years of their rule was marked by much bloodshed and anarchy, consequent on their disregard of internal affairs. About the year 756 Abdorrahman I., the last caliph of the dynasty of the Omniades (see CALIPH), having been driven from Damascus, where he was replaced

by the Abassides, succeeded in overthrowing the government of the latter in Spain, and established the independent *caliphate of Cordova*, which under Abdorhaman III. and his son Hakkem II., who died in 976, reached its zenith of power and prosperity. After the deposition of Hescham III. the caliphate rapidly declined, for when that event took place the various governors of provinces declared themselves independent, and assumed the title of kings. Thus Arabian princes reigned at Saragossa, Toledo, Valencia, and Seville, where not only the language but also the manners of the Moors at that time prevailed almost universally. Still the free exercise of their religion was allowed to the Christians, and also the retention of their language, laws, and magistracies.

Meantime the Visigoths, who had succeeded in maintaining their independence in the mountains of Asturia and Galicia, founded under Pelayo in 718 the kingdom of Oviedo. The second successor of Pelayo, Alphonso I. the Catholic, conquered Galicia, with a part of Leon and Castile, and assumed the title of King of the Asturias. The remainder of Leon was conquered by Alphonso III. (see ALPHONSO III.), whose son, Ordoño II., transferred his residence to the city of Leon, and called his dominion the Kingdom of Leon (914). The Kingdom of Navarre came into existence in the ninth century. It formed a part of the Spanish territory of Charlemagne, obtained by conquest from the Arabs, and extending south of the Pyrenees as far as the Ebro. Near the sources of the Ebro and Pisuerga arose even earlier the Kingdom of Castile. At first a small republic, consisting of only a few towns, it appears afterwards as a county with a considerably enlarged territory, and somewhat later its princes assumed the title of king. In 1037, after the death of the last king of Leon, Ferdinand I. of Castile united that kingdom with his own, and Castile was henceforth the most powerful Spanish state. Aragon, Galicia, Portugal, Murcia, and other states owed their origin to the prevailing custom of dividing a kingdom among the sons of a deceased monarch. Though frequently at war with each other the Christian princes generally united against their common foe the Moors, who were daily becoming less able to cope with them. About the end of the eleventh century Mohammed of Cordova and Seville applied for assistance against Alphonso VI. of Leon and Castile to the Almoravides, the founders of the Empire of Morocco. In compliance with the request of Mohammed the Almoravides entered Spain, and gained some successes over Alphonso; but they then turned upon Mohammed himself, obliging him to yield them a portion of his territory, and the Almoravide sovereign was ultimately acknowledged sole monarch of Mohammedan Spain. The Almoravides, however, were overpowered in their turn by another Mohammedan tribe, the Almohades, about the middle of the twelfth century. Meanwhile the Christian kings were making still further encroachments on the territory in possession of the Mohammedans, and after the great victory they obtained over the Almohades on the plains of Tolosa, in the Sierra Morena, in 1212, there remained to the Arabians only the kingdoms of Cordova and Grenada, and even these were soon afterwards obliged to recognize the supremacy of Castile. The two most important Christian states of Spain were Aragon and Castile, and they ultimately absorbed all the others. Aragon, which had been wrested from the Moors by Sancho III., and left as an independent kingdom to his son Ramiro, fell by inheritance in 1181 to the counts of Catalonia, and was afterwards greatly enlarged under successive kings. Jayme I. wrested from the Moslems the island of Majorca in 1229,

and the whole of the kingdom of Valencia in 1239. Pedro III. married Constance of Sicily, and notwithstanding the opposition of the pope took possession of that island after the massacre of the Sicilian Vespers (see SICILIAN VESPER) in 1282. Jayme II. effected the conquest of Sardinia in 1296, and Alphonso V. united Naples with his kingdom. Meanwhile the internal affairs of the kingdom had been thrown into confusion through civil dissension resulting from the heavy imposts laid upon the people; but a remedy was found in increasing the power of the Cortes. Aragon was the first Christian state in which the third estate obtained a legal position. The Cortes, consisting of representatives of the nobility, of the clergy, and of the towns, received more extensive privileges, and the king could not act in important matters without their consent. On the extinction of the Catalonian line of princes Ferdinand, infante of Castile, was elected king by the Cortes in 1412, and his descendants ruled over Aragon until, through the marriage of Ferdinand V. of Aragon with Isabella of Castile, Christian Spain was consolidated into one kingdom. Ferdinand I., second son of Sancho, was the first king of Castile in 1038, and as already mentioned joined the kingdom of Leon to the crown of Castile. He waged successful war with the Moors, took several towns, and exacted tribute from the Mohammedan king of Toledo. It is to this reign that the greater number of the exploits of the famous Rodriguez Diaz de Bivar, known under the name of the Cid, belongs; and according to Viardot the establishment of the Cortes dates from the same reign. Under Alphonso VI. Castile acquired an accession of importance through the annexation to it of the crowns of Leon (which had become again disunited), Galicia, and Navarre, and above all through the conquest of Toledo and its territory, out of which was formed New Castile. Notwithstanding the success of its arms the country suffered much. Oppressed by taxes and desolated by war it was far from being in a prosperous condition. Under Ferdinand III., who ascended the throne in 1217, Cordova, Jaen, Alcala, Seville, Cadiz, and other places were wrested from the infidels; and again under his successor Alphonso X. (1252-80) further conquests were made, though some losses were also sustained. To the latter prince is due the introduction of the third estate into the national assemblies, and the adoption of the vernacular for public acts. (See ALPHONSO X.) Alphonso XI. (1324-50), like his predecessors, spent most of his time in warring with the Moors; he gained in 1340 the celebrated battle of Salado, and made himself master of Algeiras in 1344. In 1465 Henry IV. was deposed by his turbulent vassals, and the crown given to Isabella, whose marriage with Ferdinand of Aragon in 1469 led to such important results. The marriage of these two sovereigns did not lead immediately to a complete coalescence of the two kingdoms, for they retained the separate administration of their respective dominions. But in concert with their great minister, Cardinal Ximenes, they proceeded harmoniously with the work of fusing all the states of Spain, which still differed in religion, customs, and laws, into a political and ecclesiastical unity, at the same time seeking to strengthen the royal authority at the expense of the clergy, the aristocracy, and the towns. By a severe administration of justice, and by the institution of the *Santa Hermandad*, or Holy Brotherhood—a body of about 2000 police armed and mounted for the purpose not only of putting down the robberies and violence which everywhere abounded, but also of forming a check on the power of the nobility—order was established throughout the country. The

royal power was particularly strengthened and extended by the establishment of the Inquisition, for which the faith of the Jews afforded the pretext, but the real motive of which was the wealth of that people, by which it was hoped to enrich the royal treasury. The Inquisition began its detestable mission in 1481, and in that year it is computed that about 2000 victims were burned alive, besides 17,000 persons who had their sentences commuted to less penalty than their life. More noble, however, was the warfare carried on by Ferdinand against the Moors of Granada, which, undertaken in 1481, culminated ten years later in the reduction of the capital of that kingdom, which surrendered to Ferdinand November 25, 1491. With the fall of Granada fell the Moslem empire in Spain, after having existed nearly seven centuries and a half, and Spain, with the exception of Navarre, was now consolidated into one great kingdom, fit to take a leading part in European politics. A cruel edict was about this time issued against the Jews, the Inquisition, in spite of its activity, having failed to effect all that had been expected from it. The Jews offered to purchase immunity with 30,000 ducats, but in vain; and notwithstanding the impolicy as well as injustice of the measure, an order was issued, March 30, 1492, for the expulsion of all Jews who did not submit to be baptized. Nearly the whole race thereupon, rather than sacrifice their religion to their worldly interests, left the country. In this sentence of banishment the Moors were also included, and the departure of the industrious Jews and Moors proved a fatal blow to the flourishing industry of the country, which was further affected by the discovery of America by Columbus in 1492, this being the means of withdrawing much of the activity of the nation from the improvement of the mother-country. While Spain consummated its complete political consolidation at home by the conquest of Navarre, the conquest of Naples by Gonsalvo, and still more the occupation of large portions of North, Central, and South America by Spanish generals, soon raised the new kingdom to the front rank of European powers. Ferdinand was succeeded in 1516 by his grandson Charles I. (Charles V. of Germany), who permanently united Castile and Aragon. (See CHARLES V.) At the beginning of his reign serious insurrections broke out in Valencia and Castile, where the people demanded a more liberal constitution; but they were soon quelled, and resulted in the abolition of the principal rights of the towns, the restriction of the powers of the Cortes, and a stronger attachment of the clergy and nobility to the crown. The victory of the Spaniards at Pavia, February 24, 1525, which made Francis I. the prisoner of Charles, and the expedition against Tunis and Algiers, extended the fame of the Spanish arms throughout Europe. But these wars, together with those carried on against the Protestants of Germany, against the people of Ghent in the Netherlands, and against Pope Clement VII. in Italy, exhausted the revenues of the country. The immense wealth that flowed in from Mexico, conquered by Cortez in 1518, and from Peru and Chili, conquered by Pizarro and Almagro in 1531, was not sufficient to supply the demands of the royal treasury, and though the taxes were largely increased a heavy debt had to be contracted. With the reign of Philip II. (1556-98), the son of Charles, the great monarchy began to decline. Oppression and religious intolerance, war and insurrections, occasioned the loss of the Netherlands and depopulated the rest of the monarchy; and the conquest of Portugal, which remained united with Spain from 1581 to 1640, could not prevent its decay. England and Holland triumphed over the naval force of Spain, and destroyed

her commerce; and Philip died in 1598 a bankrupt. This calamitous period was nevertheless the golden age of literature and art in Spain, and the Spanish language and fashions controlled the courts of Europe. Under the reign of the indolent and incapable Philip III. (1598-1621) the country took still greater strides towards decay. The Duke of Lerma, his insatiable favourite, in order to augment his own fortune and that of his partisans, squandered in a most scandalous manner the public revenues; and he struck another blow at the commerce of the country by expelling, in 1609, the last remnants of the Moriscos, to the number of 600,000. Equally damaging to the interests of the country was the reign of Philip IV. (1621-65), notwithstanding some energetic measures taken by Olivarez, the able minister of that monarch. The wars which were carried on in Germany, Italy, the Netherlands, and France—the war with the last-named country ending in the loss to Spain of Roussillon—helped to complete the ruin of the country, and stirred up revolts in Catalonia, Andalusia, and Portugal. The civil war in Catalonia lasted about ten years, and in 1640 Portugal recovered her independence. The son of Philip IV., Charles II. (1665-1700), a prince weak alike in mind and body, was obliged, after disastrous wars, to cede to France many places in the Netherlands and Franche Comté. The population of Spain, which had amounted to 11,000,000 in 1688, fell off to about 8,000,000 at the beginning of the eighteenth century.

Charles II., the last Spanish sovereign of the race of Hapsburg, in his second will made Philip of Anjou, a grandson of his sister, the consort of Louis XIV., sole heir of his dominions, in order to prevent the division of the Spanish monarchy, which had been resolved on in a treaty between England, Holland, and France. Louis XIV. acknowledged his grandson king, according to the testament; but the Emperor Leopold I., of the race of Hapsburg, laid claim to the throne, whilst William III., king of England and stadtholder of Holland, was in favour of a division of the monarchy for the sake of preserving the balance of power in Europe. The measures of Louis XIV. at length brought on a war with England. Thus began the war of the Spanish Succession, which lasted twelve years, and in which the Bourbon, Philip V., after many changes of fortune, succeeded in maintaining himself, by the victories of Berwick and Vendôme, on the Spanish throne in opposition to Charles of Austria (afterwards the Emperor Charles VI.) But by the Peace of Utrecht in 1713 he was obliged to resign the Spanish dependencies in Europe—Naples, Sardinia, Parma, Milan, and the Netherlands to Austria, and Sicily to Savoy. England likewise retained Gibraltar and Minorca, the latter of which was restored somewhat later. Under the Bourbons the nation lost its last constitutional rights; Aragon, Catalonia, and Valencia were treated by Philip as conquered countries. The last diet of the Cortes held in Castile was in 1713, and in Aragon in 1720. Biscay and Navarre alone retained some of their privileges. The ambition of Cardinal Alberoni involved Europe for a short time in confusion. Spain in 1735 again obtained possession of the Two Sicilies for the Infant Carlos, and of Parma for the Infant Philip in 1748. Ferdinand VI. (1746-59) succeeded his father Philip, but being a prey to hypochondria took no active part in the government. With his step-brother, Charles III. (1759-88), previously King of Naples, an enlightened prince, better days dawned for Spain. Under his reign the Bourbon family compact of 1761 involved Spain, to its injury, in the war between the French and British. The expeditions against Algiers likewise miscarried, as

did the siege of Gibraltar in the war of 1779-83. Yet this did not disturb the course of the internal administration, to the improvement of which men like Aranda, Campomanes, Olavides, and Florida Blanca devoted themselves. They provided particularly for the advancement of agriculture, the useful arts, and commerce, and this had a beneficial effect on the population, which now rapidly increased. The power of the Inquisition was restricted, and the secret opposition of the Jesuits annihilated at a blow, by the Pragmatic Sanction of April 2, 1767, which banished them from all the Spanish dominions, and confiscated their property. The progress in improvement became even more marked during the early part of the reign of Charles IV. (1788-1808), who at first pursued the reforming policy of his father; but in 1792, when Florida Blanca was superseded by Godoy as prime minister, he fell under the pernicious influence of that favourite. Spain at first entered with zeal into the war against the French Republic; but by the influence of the favourite the discreditable Peace of Basel was concluded, by which Spain resigned St. Domingo to France, an offensive and defensive alliance with France was entered on (1796), and war declared against Britain. In 1797 the Spanish fleet was defeated near Cape St. Vincent, Minorca and Trinidad occupied by the English, and all the ports of Spain blockaded. By the Peace of Amiens in 1802 the British were confirmed in their possession of Trinidad. In 1801, at the instigation of France, military operations were commenced against Portugal, which was obliged to cede the province of Olivença to Spain at the Peace of Badajoz in 1802, whilst France raised the Duke of Parma to the dignity of King of Etruria in 1801, Spain in return ceding Louisiana to France. Charles IV., on the renewal of the war between Britain and France in 1803, having purchased permission to remain neutral by a monthly tribute of 6,000,000 francs to Napoleon, the British seized the Spanish galleons, and thereby forced Spain to declare war against Britain. The victory of the British at Trafalgar, October 21, 1805, destroyed its naval power. The misery occasioned by the unfortunate wars carried on by Spain at this time led to the formation of a powerful party against the unscrupulous Godoy, who was mainly instrumental in bringing about these wars. Some feeble efforts were made by him to free Spain from French domination; but the success of Napoleon in his war with Prussia thwarted those, and in terms of the alliance subsisting between Spain and France a requisition of Napoleon to despatch two Spanish armies to Denmark and Tuscany respectively had to be complied with. Spain received a further humiliation by the Treaty of Fontainebleau respecting the division of Portugal, in consequence of which French troops were marched into the country. Towards the end of 1807 large bodies of French troops entered Spain at different points, and occupied on one pretence or another some of the strongest fortresses in the north. The entrance of a French army 35,000 strong in March, 1808, raised the numbers of French troops in the country to 100,000, and with Murat at their head they now marched on Madrid. Godoy, in despair of his life, counselled the flight of the king and queen to Mexico. The project got wind; the people broke into open insurrection, and it was only the engagement of Ferdinand that he should be brought to trial that saved the hated Godoy from falling a victim to the fury of the populace. The reign not only of the favourite but of his master also was now at an end. On the 19th of March Charles IV. abdicated in favour of his son, the Prince of the Asturias, who ascended the throne as Ferdinand VII. On the 24th of March Ferdinand made a public entry

into Madrid, which had been occupied by Murat, grand-duke of Berg, the day previous. He informed Napoleon of his assumption of the royal power; but the emperor caused the whole family to be conveyed to Bayonne, where he himself arrived on the 15th of April. Charles IV., who had retracted his resignation of the crown, and Ferdinand VII., the new king, were now both in the hands of Napoleon. Taking advantage therefore of the opportunity, he extorted from each of them, as well as from the Infantes Don Carlos and Don Antonio, a resignation of their claims to the Spanish crown. The crown, which had already been refused by his brother, Louis, king of Holland, was now offered to another brother, Joseph, the king of Naples, by whom it was accepted. The Council of Castile, the chief political body of Spain, when informed of the Treaties of Bayonne, was at length induced to give a reluctant assent to the accession of Joseph. A junta of 150 Spanish notables which had been summoned to Bayonne accepted a constitution proposed by Napoleon, July 7th, and a day or two after Joseph left Bayonne for Madrid. The Spanish people, who were so little taken into account in these changes, were by no means passive spectators of them. Insurrections had already broken out immediately after the abdication of Charles in May. The people in Asturias first took up arms; Aragon, Seville, and Badajoz followed. Palafox carried from Bayonne to Saragossa the order of Ferdinand that the people should arm; and the supreme junta received permission to assemble the Cortes. Revolution broke out everywhere, which the French were too weak to resist. Moncey retreated to Valencia; and Generals Dupont and Wedel were beaten at Baylen, July 19 and 20, 1808. On the 6th of June the junta at Seville had issued a proclamation calling the people to arms, and the Council of Castile decreed a levy of 300,000 men. On the 14th the French squadron at Cadiz surrendered to the Spaniards, and six days later an insurrection broke out in Portugal. On the 4th of July the alliance of Great Britain with the Spanish nation was proclaimed, and a struggle began, which, whatever opinion may be entertained respecting the conduct of Napoleon, everyone will admit to have brought with it, as far as respected Spain, little but evil. Marshal Bessières was successful in the battle at Medina del Rio Seco, July 14, over General Cuesta; but the affair at Baylen above mentioned decided the retreat of the French from Madrid, and, August 23, Castanos entered the city. In the meantime Sir Arthur Wellesley (Wellington) had disembarked in Portugal at the head of the British forces, and on the 21st of August gained the first important battle in the Peninsular war, defeating the French under Junot at Vimeiro. On the 30th of August the convention of Cintra was concluded, by which the French agreed to evacuate Portugal. A central junta under Florida Blanca was organized at Aranjuez towards the end of September; but unity did not prevail in it, and the favourable moment was allowed to escape. On the 6th of November Napoleon reached the Ebro at the head of a large force, and by a succession of victories gained by his generals under his direction his way was opened to Madrid, which he entered on the 4th of December. The central junta now retired to Badajoz, and afterwards to Seville. The Spaniards believed that the success of the French was owing to treachery, and this suspicion occasioned the assassination of more than one of their generals. The French indeed gained many victories and took many fortresses; but the conquerors remained masters only of the places which they occupied. Everywhere the invading troops were surrounded and harassed by the attacks of the Spanish guerrillas. No line of communication was safe for the French: their means

of support failed. In vain did Napoleon, Dec. 4, 1808, abolish the feudal privileges and the Inquisition; in vain did Joseph try every means to win the love of the people; nothing could avail against the hatred of a Gallic yoke. Austria now declared war, and Napoleon was obliged in January, 1809, to leave the conduct of the war in the Peninsula to his marshals—a step which the Spaniards considered as equal to a victory. During the following five years the French generals did all that talent and courage could do; but the charm of Napoleon's presence was wanting, and Wellington finally triumphed over them. The chief efforts of the French during the years 1809 and 1810 were directed to the conquest of Portugal, which was in the hands of the British, and the reduction of Cadiz, the last stronghold of Spanish independence. In neither of these projects, however, were they successful. In the meantime Wellington advanced from Lisbon by the way of Alcantara, up the Tagus, and Cuesta joined him near Truxillo, whilst the British general Wilson advanced over Placencia, and the Spaniard Venegas from the Sierra Morena, their design being to attack Madrid. But in spite of the victory at Talavera over Soult (July 27 and 28) and other successes against Joseph, Victor, and Jourdan, the British, not being sufficiently supported by the Spaniards, and being threatened by Soult and Ney on their flank, were obliged to abandon this bold plan and retire to the frontiers of Portugal; after which Venegas also began to retreat, and was defeated by Joseph at Almonacid, August 11, as was Wilson by Ney in the passes of Baros. Madrid thus escaped a siege. The central junta at Seville now resolved to yield to the universal wish to assemble the Cortes and to nominate a regency. New armies were created. Arezaga advanced with 55,000 men as far as Ocaña, where, however, he was entirely defeated by Mortier, November 18; but in Old Castile, Catalonia, Aragon, Biscay, and Navarre the French were powerless against the Spanish guerrillas. In 1810 Napoleon, released from every other continental war, employed all his efforts for the reduction of Spain, and for this purpose he was enabled to bring 280,000 men into the field. In the southern provinces lay the chief power of the insurrection, and these King Joseph now resolved to reduce. By the 6th of February the whole of Andalusia, with the exception of Cadiz, against which all their efforts were vain, was in the hands of the French, the opposition presented by 22,000 Spaniards under Arezaga being easily overborne by a force thrice their number. Meanwhile the central junta had fled from Seville, which Joseph entered on the 1st of February, and took refuge in Cadiz, which was effectually defended by a combined force of British and Spanish soldiers under Graham and Albuquerque respectively. In the month of April an expedition was organized by the French against Portugal. In this country, to the north of the Tagus, Wellington commanded a British army of 30,000 men, and Beresford a Portuguese army of 59,500 men, besides 52,800 militia. The right wing of Wellington at Badajoz was joined by 20,000 Spaniards under Romana and 8000 under Ballesteros. The main body of the allied force was posted on the heights of Lisbon, which had been rendered impregnable. Wellington's plan, therefore, was defensive. Masséna began his undertaking in June by the siege of Ciudad-Rodrigo, which surrendered on the 10th of July, and Ney entered Portugal, over the river Coa, on the 24th, but Almeida, which was defended by Coxé, detained Masséna until August 27, when it was obliged to capitulate. Wellington ordered the whole country through which Masséna could follow him to be laid waste; and the latter was obliged to take measures for the support of his

army during four weeks before he could proceed. At last Masséna advanced, September 18, over the Mondeja to Coimbra. On this march he was beaten on the 27th at Busaco, but nevertheless was able to occupy the heights of Sardoá, which opened to him the plains of Lisbon. Wellington now entered the strong position of Torres-Vedras, which consisted of two lines on the heights of Lisbon, defended by 170 well-placed works and 444 cannons. Masséna found this position unassailable, and retired on the 14th of November, after several engagements of little importance, to Santarém. Here he remained till March, 1811, when he was compelled by want of provisions to retreat. He was pursued by Wellington, who on the 7th of April invested Almeida. To relieve this place Masséna delivered two battles at Fuentou de Onoro, May 8d and 5th, in which he was defeated, when the French evacuated Almeida. But the French were victorious at other points. Suchet, January 2, 1811, took the important fortress of Tortosa, in Catalonia, and, June 28, after a murderous assault of five days, the fortress of Tarragona. Soult took the frontier fortresses towards Portugal, Olivença and Badajoz, March 10, and Victor defeated the British general Graham, who wished to deliver Cadiz, March 8, at Chiclana. In the autumn Suchet marched against Valencia. After having beaten the army under General Blake Saguntum fell, October 26, and Valencia surrendered, January 9, 1812. Wellington now again entered Spain. On the 19th of January he took Ciudad-Rodrigo, and, April 7, Badajoz. But he was ill supported by the Cortes and the regency, consisting of General Blake and the naval officers Agar and Ciscar. Marmont was now at the head of the army in Portugal. But the loss of the decisive battle of Salamanca, July 22, 1812, obliged him to give up the defence of Madrid. Wellington entered Madrid on the 12th of August, and on the 25th the French raised the siege of Cadiz in order to concentrate their forces in the southern and eastern parts of Spain. After the occupation of Madrid Wellington followed the enemy to Burgos; but the siege of the castle of Burgos prevented him from following up the pursuit; and after several unsuccessful assaults on this place, in which he was ill supported by the Spaniards, he retired towards Portugal; and the French again entered Madrid. Thus ended the year 1812. In the course of this year a new constitution had been drawn up (March 18) by the Cortes. The regency took the oath to maintain it, and it was recognized by the allies of Spain, and also Russia. At length Napoleon's disasters in Russia decided the fate of the Peninsula. Soult was recalled in the beginning of 1813 with 30,000 men from Spain. In May Wellington assumed the offensive by marching on Salamanca, when the French retired on Vittoria. The decisive victory gained by Wellington over Jourdan in the neighbourhood of that city, June 21st, may be said to have freed the Peninsula from all fears of France. The French retired across the Pyrenees, and took up a position under the walls of Bayonne. The victorious army forthwith invested Pampeluna, and on the 9th of July Wellington arrived at the French frontier. In the meantime (July 1) Napoleon, then in Dresden, had appointed Marshal Soult his lieutenant and commander-in-chief of his armies in Spain. Soult united the beaten corps, and opposed a considerable force to the victor. On the 24th of July the struggle began in the Pyrenees, and was maintained until August 1; but Wellington remained master of all his positions, and on August 31st took St. Sebastian by assault. It was not, however, till October 7 that he left the Pyrenees and passed the Bidassoa. After Pampeluna had fallen (October 31) no French soldier was left on the Spanish territory

except in Barcelona and some other places in Catalonia. Wellington now attacked the enemy on the fortified banks of the Nivelle (November 10), and Soult retreated into the camp of Bayonne. On the 26th of February, 1814, Wellington fought a battle with Soult at Orthez, by which the latter was driven from his strong position, and obliged to retreat, in great disorder, to the Upper Garonne. Wellington followed the French under Soult to Toulouse, where the bloody battle of April 10 and the occupation of the place put an end to the war.

The Cortes had already held its first session (Jan. 15, 1814), and had resolved that Ferdinand VII. should swear to preserve the constitution before he should be recognized as king. At their invitation Ferdinand now returned to Spain, but declared the constitution null and void; the Inquisition was revived, despotism was restored, and the greater part of the reforms introduced under Charles III. were subsequently annulled. Ferdinand bore down all opposition with a high hand, and for six years (1814 to 1820) reigned with absolute power. From 1814 to 1819 there were twenty-five changes in the ministry, mostly sudden, and attended with severities. They were produced by the influence of the *camarilla*, or persons in the personal service of the king. Every attempt to save the state was frustrated by such counsellors, and the prestige of Spain was further lowered by the loss of the American colonies, an attempt to reconquer which only resulted in a miserable failure. On January 1, 1820, a military insurrection under Riego broke out, for the purpose of restoring the constitution of 1812. It spread with great rapidity; several generals, as O'Donnell and Freyre, who were despatched to suppress it, joined the insurgents, and Ferdinand, abandoned by his own troops, was obliged to swear to observe the constitution of 1812. Among other reforms the Inquisition was abolished. The Cortes being assembled, immediately set themselves to frame such measures as should be calculated to restore tranquillity to the distracted country. But this was a task well nigh impossible under the circumstances. The country was divided into opposing factions—those who favoured the restoration of its ancient power and privileges to the crown, and those, on the other hand, who advocated liberal or ultra-liberal measures, and the measures passed had no effect in allaying the discontent. Guerilla bands were organized in the provinces in the cause of church and king, and obtained the name of 'armies of the faith.' There was even established at Seo d'Urgel in July, 1822, what was called 'a regency during the captivity of the king.' The government, however, was powerful enough to disperse these guerilla bands and drive the regency into France. In these civil disturbances dreadful atrocities were committed on both sides. In the meantime France, at the Congress of Verona in October, 1822, had agreed with the courts of eastern Europe upon an armed intervention in Spain. The Spanish government was called upon to restore the royal sovereignty, and to change the constitution; and when they declined to comply a French army 100,000 strong, under the Duke of Angoulême, crossed the Pyrenees in the spring of 1823. By means of this force Ferdinand was restored to absolute power, and immediately revoked all the decrees passed by the constitutional government between March, 1820, and October, 1823. The Inquisition, indeed, was not restored; but the secular tribunals supplied its place, and performed deeds of vengeance of the most atrocious description. The whole Spanish army was now disbanded, and its place supplied by the 'army of the faith,' who plundered and murdered the constitutionalists to their heart's content. It is computed that 40,000

constitutionalists, chiefly of the educated classes, were thrown into prison. To restrain the violence of party fury a treaty had been concluded with France, stipulating for the maintenance of a French force of 45,000 men in the country, until the Spanish army could be organized. It was only in 1827 that the French evacuated Spain. The personal moderation of the king towards the constitutionalists led to the formation of a plot by the absolutists to compel him to abdicate, and to raise Don Carlos, his brother, to the throne (thence their name of *Carlistas*). Several insurrections were set on foot by these Carlists, which were attended with numerous executions. In 1830 Ferdinand was persuaded by his wife, Maria Christina, a Neapolitan princess, to abolish, by the pragmatic sanction of March 29, the salic law of the Bourbon family, which excluded the daughters of the king from the throne. In consequence of the abolition of this law the succession passed from Don Carlos to Ferdinand's daughter, the Infanta Isabel (born October 10, 1830). Don Carlos and his party protested against this measure, and the death of Ferdinand in 1833 was the signal for civil war. Isabella was at once acknowledged by the leading powers of Europe, and proclaimed without opposition in all the midland and southern provinces of Spain. It was otherwise in the north, particularly in the Basque provinces; there the inhabitants took up arms in behalf of Don Carlos, and proclaimed him king, under the title of Charles V. Christina had the joint support of the moderados and the liberals, and in order to attach them to her still more a royal decree was issued in April, 1834, granting a constitution with two chambers. The Carlists, under the command of Zumalacarreguy, were at first successful, but on his death their cause began to decline, and the skilful leadership of Cabrera failed to retrieve the fortunes of the party. During this struggle England and France allowed men to be recruited within their territories for the cause of the queen, and an army of 10,000 went from England to join the royal troops. The chief of the royalist generals were Espartero and O'Donnell, under whose leadership the war was brought to an end in 1840. Though the civil war had thus been brought to a successful termination, Spain had by no means been restored to a state of tranquillity. Christina failed to satisfy the ultra-liberals, and rather than consent to have a colleague in the regency, as it was now thought expedient she should have, resigned altogether (October 12, 1840), and sailed for France. In May, 1841, the Cortes conferred the office of regent on Espartero, and that of guardian to the queen on Arguelles. Espartero seems to have had the good of his country at heart, but he had a most difficult card to play. Every reform which he attempted gave offence to some party, and to whatever side he turned he met only with opponents numerous, resolute, and influential. Insurrections broke out in various quarters; and Espartero, checked and hampered on all hands, at last left the country and sailed for England. Queen Isabella was declared of age by the Cortes in 1843, and henceforth the government was carried on in her name. She was married on 10th October, 1845, to her cousin, Don Francisco d'Assiz, her only sister, Louisa, being on the same day married to Louis Philippe's son, the Duke of Montpensier. The outbreak of the French revolution of 1848 caused much less commotion in Spain than in several other continental states. Any revolutionary movements that took place were easily repressed by Narvaez, a minister of prudence and energy, who was then at the head of the government. Narvaez, however, found no small difficulty in maintaining his position. The court was a mere focus of intrigue, and the most important political changes

were constantly threatened to be effected by the most frivolous and contemptible means. Early in 1851 he was compelled to resign; and till 1854 a number of short-lived and weak ministries, most of which had reactionary tendencies, succeeded each other. At the head of the last of them was Sartorius, whose measures were so unpopular that insurrections broke out in various quarters; and he and his colleagues, after trying in vain to suppress them, were obliged to save themselves by flight on the 17th of July, 1854. Espartero, who had some time before returned to Spain, was now charged with the formation of a government in accordance with the wishes of the nation. Before consenting to undertake this task he made two stipulations—the one that the queen mother should be exiled, the other that the constituent Cortes should be assembled. On obtaining these concessions he formed a coalition ministry, himself holding the office of president, and General O'Donnell that of minister of war. The coalition ministry did not, however, work harmoniously; and Espartero, after holding his position with some difficulty till the 14th of July, 1856, was obliged to give place to another ministry, with O'Donnell at its head, which only existed three months. Narvaez was now called to the head of affairs (October, 1856). But in July, 1858, O'Donnell was again intrusted with the formation of a ministry, which, being more liberal than the previous ones, endured for a period of five years, during which Spain enjoyed comparative tranquillity. In 1858 Spain shared in the French expedition against Anam, to avenge the persecution of Catholic missionaries and native Christians, which had been going on for a series of years. On October 22, 1859, war was declared against Morocco, which, it was alleged, had attacked the Spanish possessions situated on the northern coast of that state. Under the leadership of O'Donnell it was carried to a successful conclusion, and a treaty of peace was signed on the 26th of April, 1860, in terms of which 20,000,000 piastres were paid to the Spaniards by way of indemnification. These foreign wars led to a considerable increase of the army and navy, promoted peace at home, and greatly raised the reputation and influence of Spain abroad. In 1860 an unsuccessful attempt was made to overthrow the government of Isabella by the Count of Montemolin, the eldest son of Don Carlos, in whose favour the latter had in 1845 abandoned his claim to the Spanish throne. In 1861 Spain joined Britain and France in sending an expedition to Mexico to obtain redress of grievances. The same year Spain resumed possession of her former colony of San Domingo. On March 18th of the last president of that republic, Santana, issued a proclamation announcing the union of that state with Spain; and on the 20th of May the queen signed the decree by which the annexation was accepted. In 1863, however, a revolt broke out, and after some fighting, which continued into the following year, Spain relinquished the possession once more. A quarrel at this time broke out between Spain and Peru, in consequence of which the Spaniards seized the Chincha Islands by way of material guarantee; but in the early part of 1865 the differences between the two governments were adjusted, and the Chincha Islands restored to the Peruvian authorities. A more serious rupture took place later in the same year with Chili, which led to a war between the two countries. The Chilians were supported by Peru, Ecuador, and Bolivia; but Spain had not very much to fear from this combination, though at the same time, as might have been expected, the war procured her little either of honour or profit. A military insurrection broke out in Spain towards the end of 1865, under the leadership of General Prim, but he and his adher-

ents were forced to flee before the royal troops. Prim effected his escape to Portugal, but in the following year another attempt at insurrection was made. On the 22d of June a regiment of artillery, quartered in Madrid, mutinied in their barracks; and after murdering several of their officers marched through the streets of the city calling upon the people to rise in the name of 'Prim and the republic.' The active measures, however, of the prime minister, Marshal O'Donnell, soon put down the revolt. An equally abortive rising, though on a larger scale, took place in August, 1867, in Aragon, Catalonia, Valencia, and elsewhere, where bands of armed men made their appearance, and were in some instances joined by the mayors of towns and other functionaries. The movement in a short time wholly collapsed, and several persons engaged in it were taken prisoners and executed. But the revolution of 1868 had a very different issue. The conduct of the queen had alienated all feelings of loyalty in the breasts of her subjects. The forms of the constitution had been abused, and made the machinery of arbitrary and oppressive rule, and the people were weary of a system which repressed all freedom of thought and rights of conscience, which placed the education of the young in the hands of Jesuits, and under which they had lost all respect for their ministers and all attachment to the crown. In the month of April insurrectionary movements broke out in Catalonia, and the province was placed in a state of siege. In July several Spanish generals were arrested by the government, and without any form of trial sent into exile. The revolution burst forth in September. On the 17th of that month General Prim arrived at Cadiz, where the exiled generals also arrived two days later, and immediately lent themselves to the movement. Meanwhile a proclamation had been issued calling the people to arms. Marshal Serrano, formerly president of the senate, placed himself at the head of the movement, and the whole of Andalusia pronounced for the revolution. The Spanish ministry resigned, and General Concha was appointed by the queen president of the council. The Marquis de Novaliches commanded the royal army, and marched upon Cordova, which was occupied by the insurgents. At Burgos a severe conflict took place, which resulted in the royal troops fraternizing with the people. Juntas were established in the different towns, which one after another raised the flag of rebellion. The defeat of Novaliches at Puerta Alcala and the formation of a provisory junta at Madrid determined Isabella to flee the country and take refuge in France. Immediately after her flight the fall of the Bourbons was solemnly proclaimed, and one of the first acts of the juntas was to recognize universal suffrage as a principle of the future constitution. Serrano entered Madrid at the head of the revolutionary troops on the 3d of October, and was received with the utmost enthusiasm by the inhabitants. A few days later a provisional ministry was formed, 'to lead the nation to liberty, and not allow it to perish in anarchy.' Decrees were passed suppressing the society of the Jesuits, declaring the absolute freedom of primary education, and restoring the liberty of the press. Thus was accomplished with little violence and less bloodshed a revolution which marks one of the most important eras in Spanish history. The Cortes of 1868 declared for the monarchical form of government: but it was no easy task to find a prince both able and willing to fill the hazardous post of king. After fruitless negotiations with several princes, which, in the case of one of them, the Prince of Hohenzollern, led indirectly to the disastrous Franco-Prussian war of 1870, the crown was at length accepted by Amadeus, the second son of Victor Emmanuel, and on

the 16th of November, 1870, he was formally elected as king by the Cortes. Meanwhile insurrectionary movements in several of the provinces had disturbed the peace of the country, but were forcibly suppressed. The new constitution was promulgated June 6th, 1869, and Serrano appointed regent until a king was elected. The two years' reign of Amadeus I. failed to give peace to the much disturbed country. Parties were numerous and irreconcilable. One ministry had to give place to another, each successive change making matters worse instead of better. To crown all, in April, 1872, the Carlist resurrection, which had been for some time threatening, burst forth. Risings took place simultaneously, under old chiefs of the party, in Aragon, Navarre, and the Basque Provinces; and bands also rapidly formed in Leon, Castile, and elsewhere. The cry of 'Viva Carlos VII.' was heard on all sides. No time was lost by the government in despatching Marshal Serrano to the scene of action. He succeeded in driving the insurgents before him, and coming up with the main body on the 4th of May, at Oroquieta, defeated them. The check they received was, however, only temporary, as they still kept up a species of guerrilla warfare, and the year 1872 closed amidst wide-spread confusion in the provinces, and excitement in the capital itself. 'The Carlists in the north, the federalists in the south, overran the country, exacting contributions, cutting the railways and telegraph wires, inflicting heavy damages upon the state and on private families, putting a stop to all commercial intercourse, undermining local trade, protecting and facilitating smuggling, and obtaining unlimited authority wherever they went'; and in this state of disorganization the country continued long after all active fighting had ceased. Disaffection in the army added to the strife of parties, and the many opposing manifestations of public opinion at length determined the king to resign a crown the wearing of which had caused him nothing but anxiety and unrest. He accordingly abdicated on the 11th of February, 1873; and immediately thereupon the Cortes, by a majority of votes, declared for a republic, which was officially proclaimed at Madrid on the 16th of February. This was followed by political complications of the most chaotic description, a state of affairs which the Carlists were not slow in taking advantage of. Not only, however, were the Carlists active, but other insurrectionary movements, consequent on the general discontent, combined to complicate the difficulties of the government. On the 8th of June the form of government, which had been the subject of much dispute, was, by an almost unanimous vote of the Cortes, definitively declared to be that of a federal republic. The ministers under it were as short-lived as previously. On Sept. 21 Castelar, who at that time was president, was invested with dictatorial powers by a resolution of the Cortes, who voted their own suspension till Jan. 3, 1874. At the expiration of that period matters were in no way improved. Public opinion was wholly disorganized, and the Carlist war had gained formidable dimensions. January 3 saw another revolution of government; the Cortes had reassembled, and on a motion being made for the approval of Castelar's exercise of authority during the recess it was negatived by a large majority. Castelar at once presented the resignation of himself and cabinet. As soon as this event was known out of doors, General Pavia, the captain-general of Madrid, at the head of his troops, entered the chamber, and forcibly dissolved the Cortes; and having assembled the chiefs of the revolution of 1868, and leading men of all political parties, justified his conduct by the urgency of the case, and desired them to form a new coalition ministry. The parties now placed in power, with Serrano

at their head, were the same with those who made the revolution of 1868 and the constitution of 1869. During this new revolution Madrid remained tranquil; but in Saragossa, Barcelona, and Valencia volunteers were arrayed by the communal authorities against the troops of the government, and barricades were raised. The struggle, however, was of short duration, and soon quelled. Within ten days after the inauguration of the new government a striking military success, in the capture of Cartagena from the disaffected, came to give it credit. In the north the Carlist war still raged, and became more and more formidable. Bilbao made a stubborn resistance to the government troops, but ultimately fell, and this success was followed by a few others; but at the battle of Estella, fought on the 27th of June, the Carlists obtained a signal victory over the republicans, who lost nearly 5000 men in killed, wounded, and prisoners. The Carlists now overran the north-eastern provinces, the fortresses only holding out against them. On the 15th of July, after a terrible bombardment, Cuenca fell into their hands. By the beginning of September the pretender's troops had entered several towns in different parts of Spain, though they had been, for the most part, unable to retain their acquisitions. The tide of success, however, again turned against the Carlists. They met with a signal defeat near Pampeluna on September 25, and again at Irun on November 11; but the republicans failed to follow up their successes or act as if they had any desire to bring the war to a speedy conclusion. Meanwhile another political change was in contemplation. The Alfonsists, or advocates of the Prince of Asturias, son of the ex-queen, consisting of a large majority of the middle and upper classes of society, had been working steadily in his interests. On the prince's seventeenth birthday (November 28) addresses had been presented to him at Sandhurst, in England, where he was pursuing his military studies as cadet; and on the last day of the year it was announced that General Martinez Campos, proclaiming Prince Alfonso as king, had entered Valencia with two brigades. On the same day he was proclaimed in Madrid under the title of Alfonso XII. On the 9th of January, 1875, the new king landed at Barcelona, and assumed the government of Spain. The Carlist rebellion dragged itself on for more than a year after this event, but with fainter and fainter hopes of success. On the 22nd of Feb. 1876, five battalions of Carlists surrendered at Tolosa to General Campos, and four days later Don Carlos himself fled to France. On the 20th of March following the young king made a triumphal entry into Madrid. Spain enjoyed a time of peace until his death in his 29th year, Nov. 1885. His wife, Christina of Austria, was proclaimed regent after the birth in 1886 of her posthumous son, who is now king under the title of Alfonso XIII. Besides her struggles with the Carlists and others at home, Spain had to contend from 1868 to 1878, and again from 1895 onwards, against insurgents in Cuba, where rebellion seemed almost the normal state of affairs. The United States intervened in 1898, and war ensued, resulting in the defeat of Spain, the almost complete destruction of her navy, and the loss of her American and Asiatic colonies. For the history of Spain see Lafuente's *Historia General de España* (1850-67; new edition, 1888); Cavanille's *Historia de España*, (1861-65); Montesa and Manrique's *Historia de la Legislacion, &c., de España* (1861-64), and *Historia General de España* (1890); Diercks's *Geschichte Spaniens von den frühesten Zeiten bis auf die Gegenwart* (1894-95); Burke's *History of Spain* (1895); Hume's *Modern Spain* (1899), and *History of the Spanish*

People (1901). For the history of the Moorish dominion consult the works of Conde, Aschbach, and Dozy; for the times of Ferdinand and Isabella and of Philip II., those of Prescott; and for the Peninsular war, those of Foy, Southey, Napier, Suchet, &c.

*Spanish Language.*—The Spanish language belongs to the group known as the Romance or Romanic languages. (See ROMANCE LANGUAGES.) Besides being the language of Spain it is the language of Mexico, and a great part of South America. The lengthened duration in Spain of Roman institutions, to which that country assimilated itself more completely than any other nation of Europe; and the firmer establishment there of the church, which perpetuated the literary traditions of Rome—caused a closer approximation of the Spanish to the Latin than even the Italian. The conquest of the country by the Visigoths naturally exercised a powerful influence on the development of the language; and it has been estimated that one-tenth of the words in Spanish are of Teutonic origin. The prolonged occupation of the country by the Moors had likewise an important influence on the constitution of the language, and gave it somewhat of an oriental tinge. There are a good many words of Arabic origin in Spanish. A number of different dialects developed themselves at an early date, but of these the Castilian took the lead, and came to be considered as the standard of Spanish, becoming the idiom of the court and the learned. Portuguese was at one time but a Spanish dialect, but it has succeeded in gaining recognition as a separate language. The Castilian idiom originated in the mountains of the interior of Spain, and like that of the Doric mountaineers among the Greeks was characterized by deep and open tones, which now distinguish the Spanish from the Portuguese. The latter we may compare to the Ionic dialect in the Greek language. The Spanish language has twenty-seven letters or signs of as many distinct sounds, of which two, *ll* and *ñ* (pronounced like *lli* in *brilliant* and *ni* in *union*) are peculiar to it. All the letters are pronounced, except *h*, whatever their position may be. The vowels, unlike the English, remain invariable in sound; thus *a* always sounds like *a* in *far*, *o* like *o* in *go*, &c. Some of the consonants have peculiar sounds, as *j*, which is always pronounced like the German *ch*, or *ch* in the Scotch word *loch*; *g* has likewise the same sound when it precedes *e* or *i*; *z* invariably, and *c* before *e* and *i*, are pronounced like the English *th*; lastly, *b* is sometimes pronounced *v*, and *vice versa*, the more correct sound being one intermediate between *b* and *v*. There are only the two genders for nouns—masculine and feminine; but the article has three forms—*el*, *la*, and *lo*; the last is employed before an adjective to give it the force of a noun. The plural is formed by adding *s* or *es* to the singular. There is properly no declension, prepositions being used instead of inflections. The Spanish is unusually rich in augmentative and diminutive terminations, which have gradually become the regular and exclusive means of adding to the original meaning of words the idea of greatness or smallness, admiration or contempt. The comparison of adjectives is effected by prefixing to the positive *mas*, more, for the comparative, and the same with the definitive article for the superlative; though, unlike the kindred idioms of Italian and French, there is an absolute superlative in Spanish formed by affixing *ísimo* to the positive. In the subjunctive of the verb there are four more tenses than the kindred languages possess, namely, two simple tenses, the future and the second conditional; and two compound tenses, the future perfect and the conditional perfect. The Spanish has only three

conjugations, but, unlike the other Romance languages, it has a double set of auxiliary verbs, *haber* and *tener*, *ser* and *estar*, and uses the reflexive form of the verb more extensively than any other European language. As an instrument of science and philosophy the Spanish is weak; but for poetic productions it is unrivalled, being at once harmonious, sonorous, and precise, abounding in imagery and metaphor, and peculiarly fitted to express the dignified and the pathetic.—The best native grammars are those of the Spanish Academy, of Salva, and of Bello and Cuervo; of foreign ones in English, those of Schele de Vere, Prof. W. J. Knapp, C. M. Sauer, and M. M. Ramsey. See also Diez, *Grammatik der Romanischen Sprachen*. Of dictionaries those of the Spanish Academy and of R. J. Dominguez (both for Spaniards), the Spanish and German by Tolhausen, and the Spanish and English (pronouncing) by Velazquez, are especially valuable.

*Spanish Literature.*—The national literature of Spain dates only from the twelfth century; but the literary life of the people is much older, as under the rule of the Romans Spain, which became a chief seat of Roman civilization, was also one of the centres of Latin literature. In Spain, as elsewhere, the first stage of literary development was in the province of poetry. The time when Spanish poetry began to flourish coincides with the origin of the Italian epic, being just at the period when the Provençal poetry expired, in the middle of the fourteenth century. The age of the Provençal poetry could not last long in Spain. The life of the Spaniard, filled with battle and toil, was too grave to allow him to be satisfied with poetry of so gay and often trifling a character. Only at the court of Aragon, and for a short time at that of the King of Castile, were there courts of love and wandering minstrels. The more Castile extended its power from the centre of Spain the more did the Provençal poetry retire from Aragon, Catalonia, and Valencia to France. Castilian poetry began with the ballad, passed over to the romance, and reached its highest point in the drama, and in each of these departments always remained of a decidedly romantic character. Spanish poetry differs from the Italian by a peculiar mixture of romantic fervour, frequently of an oriental kind, with deep gravity. The Moors may have added to this spirit, besides having introduced into Spanish fiction the fairy world of the East. Spanish poetry proceeds always with a solemn pace. Its plays of wit are heavy, and its fondness for allegory excessive. The perfection of the intrigue is one of the great merits of Spanish writers, and they have served as models to the rest of Europe. A great peculiarity of Spanish versification is found in the *redondillas*, which became not only the standing metre of the ballad but also of the drama, and in the *assonances*, which the Spaniards carried to the highest perfection. *Redondillas*, in their later form, are strophes of four lines in trochaic verses, mostly of four feet, and are peculiarly adapted for Spanish poetry. In the Spanish sonnets, prior to the connection with Italy, they assumed the most popular character. The rhyme alone did not satisfy the writers, but the assonance was carried through whole lines. The song was the natural growth of the warlike period of Spain, and served to commemorate martial exploits. No language has such a store of ballads as the Spanish; but they are, particularly the earlier ones, little more than simple childlike relations of chivalrous deeds. They may be properly divided into the chivalrous (derived especially from the fabulous history of Charlemagne, in which are mingled also tales of Moorish and Spanish heroes, as Don Gayferos, the Moorish Calaynos, Count Alarocs, &c.) and the historical; of the latter kind

an endless number originated during the struggle with the Moors. After those which belong to the early times of these conflicts, in the ninth and tenth centuries, there arose the brilliant ballads relating to the Cid, the hero of the first Castilian king, Ferdinand. Their nature is fully exhibited to us in probably the earliest poem of length relating to this subject which has been preserved, *El Poema de Cid*—a story whose simplicity and poetic colouring are very striking. It is nothing more, and in this early childhood of Spanish poetry could be nothing more, than a long historical Spanish ballad, without any plot. It belongs, according to all conjecture, to the twelfth century, and is much superior to the *Poema de Alexandro Magno*, which is of nearly equal antiquity, and to the rhymed prayers, legends, and rules of religious orders by the Benedictine monk Gonzalo Berceo. In connection with these ballads should be read those which are taken from the history of the Moors, of which many are found in the *Historia de los Vandos de los Zegris y Abencerrages*, which is itself a sort of romantic chronicle of the Moorish heroes. There are also a number of Spanish ballads, founded on various popular stories. Little different from the ballad was the song; and perhaps the whole difference, especially in the thirteenth and fourteenth centuries, consisted in this, that the song was divided into couplets or small strophes. Subsequently the song became more lyrical; and then arose the *canciones*, properly so called (in twelve lines, similar to the madrigal and the epigram), the kindred species of *villancicos* (stanzas of seven lines), and the poetical paraphrases of known songs and ballads, in which the old songs were interwoven, line by line, with the words unchanged. Spain is distinguished above other countries for having united the greatest part of her ballads and songs in large collections, and thus preserved them to posterity; and the only thing to be regretted is that the date and the author are not generally given. Thus there is a great collection of ballads made in the sixteenth century, called *Romancero General* (by Miguel de Madrigal, 1604, and Petro de Flores, 1614), and an older one, *Cancionero de Romances*, &c. (Antwerp, 1555). The songs are to be found in the *Cancionero General* of Fernando del Castillo, which belongs to the commencement of the sixteenth century, and was preceded by a *Cancionero de Poetas Antiguos*, in the reign of John II. Crowned heads, as Alfonso X. in the thirteenth century, and the Castilian prince Don Juan Manuel (who died in 1362), had tried their powers in verse and prose; and Manuel's work, the *Count Lucanor*, a collection of important rules for the lives of princes, remains a beautiful monument of Spanish refinement in the fourteenth century. The knights themselves, and not, as in other lands, merely monks, had employed themselves in writing chronicles; and the Spanish historical style has hence become more dignified and noble. The pursuits of active life and of literature have been so intimately connected in Spain that its greatest warriors have been also the most intellectually cultivated, and not unfrequently were distinguished poets. Thus we find, in the fifteenth century, at the court of John II., celebrated as a patron of poetry, the Marquis Henry de Villena, who has left the oldest Spanish Art of Poetry, under the title of *La Gaya Ciencia* (The Gay Science), and from his knowledge of natural philosophy almost acquired the reputation of a magician; and his yet more celebrated pupil Don Inigo Lopez de Mendoza, marquis of Santillana, author, among other works, of the *Doctrinal de Privados* (Manual of Favourites), in which the favourite of John II., Don Alvaro de Luna, who was executed, relates his transgressions, and enjoins moral truths on the turbulent Castilians.

Santillana's letter upon the oldest Spanish poetry is very celebrated. Several others—for instance, Juan de Mena (the Spanish Ennius), who died in 1456, author of the allegoric-historical-didactic poem, *Las Trecentas* (The Three Hundred Stanzas), and Rodriguez del Padron, who in his songs of love exchanged his French idiom for the Castilian—received distinguished favours from the above-mentioned king. Attempts were now made in all branches of the art. During the reign of John II. and his celebrated daughter Isabella the dramatic spirit first prevailed. Yet before the time of Juan de la Enzina, who about the end of the fifteenth century composed pastoral dramas (also the author of the *Disparates*, which is in the ballad form), the Marquis de Villena encouraged the writing of allegorical plays, and an unknown author produced the celebrated satirical pastoral dialogue *Mingo Rebulgo*. Then followed the dramatic romance of Callistus and Meliboea, which was also called a *tragi-comedy*. Some historical and biographical works of importance appeared at the same time. The *Chronicles* of the poet Perez de Guzman, and of the High-chancellor of Castile, Pedro Lopez de Ayala, have been reprinted in modern times by the Academy of History at Madrid. The *History of the Count Pedro Nino de Buelna*, by Gutierre Diaz de Ganes; the *History of Alvaro de Luna*, by an unknown friend; and the *Claros Varones of Fernando de Pulgar*, still preserve their reputation.

The second period of Spanish literature begins when the whole monarchy was permanently united under Ferdinand and the Catholic. Spain and Italy were brought into connection, by the conquest of Naples, under the great captain (*el gran capitán*) Gonsalvo Fernandez de Cordova; the Inquisition, which, restraining the faith of the Spaniards, left freer room to its fancy, was established, and America discovered. Juan Boscan Almogaver (about the year 1526), nourished by Italian genius, gave Castilian poetry a classic character, by judiciously incorporating in it the excellencies of his Italian models, especially Dante and Petrarch. He confined himself to sonnets and songs; but his friend Garcilaso de la Vega (died 1536) became the author of very popular pastoral poems, to which, in later times, the Portuguese Saa de Miranda and Montemayor gave a more elevated character; the latter, in his pastoral romance *Diana*. More imbued with the spirit of Horace and Aristotle was the distinguished statesman Diego Hurtado de Mendoza (died 1575) the dreaded minister of Charles V., in Italy, and author of the comic romance *Lazarillo de Tormes*, a work of decided genius, who composed, upon the model of Sallust and Tacitus, his *History of the Rebellion in Granada*. He wrote various songs, poetical epistles, and satirical pieces. In odes, in the new style, Fernando de Herrera (died 1597) and Luis de Leon (died 1591) met with much success. These two are considered the greatest lyric poets that Spain has ever produced. The poetry of the latter is chiefly religious, and deeply imbued with mysticism. The witty Castillejo was particularly inimical to this classic Italian school. All attempts to imitate the romantic epic of the Italians in Spanish literature failed; and, in fact, even the later attempts of the Spaniards in the epic have been unsuccessful, if we except the *Araucana* of Alonso de Ercilla y Zúñiga (about 1556), which celebrates the conquest of a brave tribe of American Indians.

But the fairest flower of the Spanish Parnassus now opened. We mean its drama. The history of this henceforth embraces nearly all the history of Spanish poetry. The Spanish drama does not recognize the Grecian distinction of comedy and tragedy, but its

peculiar divisions are the *comedias divinas* and *comedias humanas*. The former have been divided since Lope de Vega into histories of the lives of the saints (*vidas de santos*); and *autos sacramentales*, plays which were performed upon Corpus Christi days, and had for their object the commemoration of the sacrament. The *comedias humanas* consist of three classes:—1. The heroic, more properly historical in their nature; 2, pieces of the cloak and the sword (*comedias de capa y espada*), drawn from high life, and full of the most complicated intrigue; 3, the *comedias de figuron*, in which vain adventurers or ladies play the chief parts.

In the first half of the sixteenth century, which begins the *third period* or the golden age of Spanish literature, after a learned party had attempted, without success, to imitate the Grecian and Roman drama, Torres Naharro appeared, and laid the foundation of Spanish comedy; and Lope de Rueda, called by Cervantes the *great*, followed with pieces in prose. From rude beginnings, among which we must not omit the two tragedies on the history of Ines de Castro, by the Dominican Bermudez, the drama unfolded itself, until the time of Cervantes, the rival of Lope de Vega. Lope de Vega (born 1562) held the highest rank before the appearance of Calderon. In all the above-mentioned kinds of Spanish comedy he obtained unbounded applause; and his fertility is astounding. He possessed an inexhaustible power of inventing complicated intrigues, but wanted the highest kind of refinement. A crowd of imitators surrounded him (among whom we may mention Mira de Mesca); but the drama was carried to its highest perfection by the immortal Pedro Calderon de la Barca, who was born in 1660. He was the friend and poet of Philip IV., who had a great fondness for the stage, and himself wrote for it. (See CALDERON.) His example also allured a swarm of feeble imitators; but Solis, Moreto, Molina, Roxas de Castro, and others, should be mentioned with respect.

In one of the finest departments of works of fiction—the romance—Spain has accomplished much. The romance of chivalry early received a peculiar character in the *Amadis* (probably by Vasco Lobeira, in the fourteenth century), and flourished for a long time. Its principal productions we may best learn from the judgment passed on them by the curate and barber in Don Quixote. Diego de Mendoza, in his *Lazarillo de Tormes*, furnished the model of the romances of low life (*del gusto picaresco*) which afterwards became so numerous, and of which Don Guzman de Alfarache, by Mattheo Aleman (1599), is one of the most distinguished. A flood of other tales appeared about the same time, among which must be mentioned those of Timoneda and Perez de Montalvan. But the immortal Miguel de Cervantes Saavedra (born in 1547), in his *Don Quixote*, surpasses all his predecessors and followers. In this Spanish prose found its perfection; and the work makes an epoch in the history of romance—a circumstance which would not have been so much overlooked had it not been customary to consider the knight of La Mancha only as a subject of jest, and to put out of sight the fact that the work affords the most vivid picture of human life. With the addition of the other works of Cervantes the circle of poetic creation in Spain may be said to be completed. With the decline of the state Spanish literature likewise declined. The brothers Argensola, with the title of the Spanish Horaces, many writers of epic, pastoral and lyric poetry, of moderate merit, Espinel, Morales, the Figueras, Sousa, Virues, Montalvan, rise a little above the general level. The usual appearances of a declining poetry and literature are observed here.

The ingenious but affected Louis de Gongora de Argote (after 1600) soon carried a bombastic and strained mode of writing to a great height, and found many followers both in poetry and prose. Spain had likewise at this time, as Italy at an earlier period, her Marinists, or concettists, who largely indulged in metaphors and puns, and a peculiar class called *culturists*, who veiled their want of genius in turgidity and affectation. The cultivation of the prose style during this period was not neglected, particularly in works relating to the history of the nation. The learned theologian Perez de Olivia, who died in 1533, much improved didactic prose, and his scholar and nephew, Ambrosio de Morales, the historiographer of Philip II., followed in his footsteps. Diego de Mendoza wrote, as we have already mentioned, a History of the War in Grenada and Geronymo Zurita *Anales de la Corona de Aragon*. Antonio de Solis wrote in the seventeenth century an excellent work on the conquest of Mexico; yet the Jesuit Mariana deserves perhaps to be called the most industrious Spanish historian. Lorenzo and Balthazar Gracian, the latter of whom, by his *Arte de Ingenio*, had an important influence on the Spanish literature of the seventeenth century, contributed to the introduction of Gongora's defects into the prose style. In this, no less than in the other periods of Spanish literature, no works of importance are to be found in philosophy or theology.

The *fourth period*, which begins with the accession of the Bourbon family in 1701, embraces the collapse of the old national literature, the intrusion of foreign elements, and the attempts made to restore the native element, and fuse it with the best elements of modern European civilization.

Foremost among those who introduced the French element into Spanish literature was Ignacio de Luzan, who in his *Poetica* (1737, folio) applied the rules of French criticism to native literature, and in his own poems tried to substitute brilliancy for genuine poetry. Against the tendency thus inaugurated arose a reactionary movement which had in Garcia de la Huerta one of its best exponents, theoretical as well as practical. A middle course was pursued by the school of Salamanca, which, avoiding the excesses, sought to combine the merits of both parties. The chief of this school of moderate reformers was Melindez Valdes, a veritable poet, whose productions could rouse the enthusiasm of the nation. Iglesias, Noroña, Quintana, Cienfuegos, Ariza and Gallego, followed in addition to French, English, and Italian models, at the same time that they preserved a Spanish colouring and Spanish ideas. The liberation of the country from French domination in 1812 had the effect of giving to its literature a more independent and more national character, as is manifest in the poetical works of Xerica, Lista, Martinez de la Rosa, Jose Joaquin de Mora, Angel de Saavedra and Breton de los Herreros. The number of recent poets is very considerable, and among the most celebrated of them appear the names of Tapia, Maury, Juan Bautista Alonso (*Poesias*, Madrid, 1834), Jacinto de Quiroga (*Poesias*, 1834), B. de Campoamor (*Poesias*, 1840), Espronceda, Serafin Calderon, Zorrilla, Hartzenbusch, Santos Lopez Pelegrin, the satirist Villergas, and Gertrudis Gomez de Avellaneda. The attempts to cultivate the epic muse have been even less successful than in former periods; but the department of romance boasts a few names of some prominence, the chief being that of Saavedra. In dramatic poetry Leandro Fernandez Moratin, a chief exponent of the French classic school, secured for himself a permanent place on the stage, and exercised no small influence on the dramatic art. The subsequent pre-

dominance of the romantic school in France had a marked effect on the Spanish drama, though it was opposed by some of the leading writers, as Breton, Saavedra, Hartzenbusch, Trueba and others. In history Ulloa, Muñoz, Capmany, Ferreras, Quintana, Navarrete, Clemencin, Torreno, and Muñoz Maldonado have in modern times distinguished themselves as historians. Among the best political orators appear the names of Jovellanos, who also wrote on legislation and political economy, Arguelles, Minaño Marina, Larra, Donoso Cortes, Martínez de la Rosa, and others; while the best works of fiction are from the pens of Humara y Salamanaca, Escosura, M. de la Rosa, Espronceda, Larra, Villalta, Serafin Calderon, Gertrudis de Avellaneda, and Fernan Caballero (Cecilia Böhl von Faber), whose novels have acquired a European reputation. In the latter department of literature the novels of France and England have exercised a considerable influence. In general Spanish literature is rapidly advancing in importance, and promises to occupy a prominent place in the literature of Europe.

In the department of science generally, and particularly in theology and philosophy, comparatively few names have acquired a more than local reputation. The first great philosopher of Spain, Jaime Lucio Balmes (died 1849), belongs to the present century. In political economy Jovellanos, Cabarrus, Canga-Arguelles, and Florez have earned a European reputation. In philology no works of surpassing merit have appeared. Among the most celebrated philologists of modern Spain are the orientalist Casiri and Gayangos. Among the most noteworthy scientific publications of the present century are the *Enciclopedia Española del siglo XIX.*, and the *Biblioteca universal de instruccion*. The great work on Spanish literature is that of George Ticknor (Boston, 1849-54; third edition, 1864), which has been translated into Spanish and German. See also Bouterwek and Sismondi's works on the same subject, which have been translated both into Spanish and English. Another valuable work is the *Studien zur Geschichte der Spanischen und Portugiesischen Nationalliteratur*, by F. Wolf (Berlin, 1859). The (unfinished) work of Amador de los Rios, entitled *Historia Critica de la Literatura Española*, takes high rank among native works, as does also Pelayo's *Historia de las Ideas Estéticas in España* (1884-86, 3 vols.). An important undertaking was begun in 1846 and carried on under the auspices of the government. This was the *Biblioteca de Autores Españoles*, completed in 1880 in 70 volumes, and comprising the works of all the great writers of Spain.

*Spanish Architecture, Painting, &c.*—In spite of the adverse circumstances which the Spanish nation has had all along to contend with, the cultivation of the fine arts has never been entirely neglected. On the contrary, not a few of her monuments of art contrast favourably with those of any other civilized nation. In architecture the edifices of the Roman period for a long time served as models to the Spaniards, and there yet exist many erections throughout Spain to prove this. Of the immense edifices of the Visigoths nothing remains, while on all sides proofs are to be met with of the architectural grandeur of the Moorish period (711-1492). Among the extant monuments is the magnificent palace of the Moorish kings at Granada, the celebrated Alhambra. The interior of this immense building was of almost unexampled magnificence. It was in the purely oriental style, with its colonnaded walks, gardens with sparkling fountains, baths, splendid saloons, above which hung the rich roof, gilded and starred like a heaven. The architecture of the Arabs, says Owen Jones, 'is essentially religious, and the

offspring of the Koran, as Gothic architecture is of the Bible.' The Romanesque architecture, which insensibly extended southwards with the Christian kingdoms, offers few edifices of any importance. An example of this style is seen in the cathedral of Tarragona. On the other hand Spain is particularly rich in Gothic structures, which mostly date from the latter part of the fourteenth century. One of the oldest and grandest of these is the cathedral of Toledo, begun in 1227; while the cathedrals of Barcelona and Seville date from the end of the period. The decline of Spanish architecture dates from the sixteenth century, when Italian models were followed. Among the more distinguished of later architects may be mentioned Juan de Toledo and Juan de Herrera, who designed the Escorial; Filippo Ivra (1685-1735), and more recently Mariano Lopez Aguado, Custodio Teodoro Moreno, Inclan Valdes, and Annibal Alvarez. In sculpture Spain is particularly poor, and not till the present century do we meet with any sculptors of note. Jose Alvarez, Antonio Sola, Medina, Ponzano, Francisco Perez del Valle, and Fr. Elias are among the more illustrious sculptors. In painting, though a few names are met with earlier than the sixteenth century, it is only then that anything like a native school appears. The school which had most influence on Spanish painting was the Venetian, more particularly as represented by Titian; and the two famous schools of the seventeenth century, those of Madrid and Seville, exhibit this influence in a marked degree. To the school of Seville belong Francisco Pacheco (born in 1571); Juan de la Roelas (born in 1558); the two Herreras; the three Castillos, of whom the most celebrated was Juan, the master of Murillo; Francisco Zurbaran (1598-1662), who first fixed the style of this school; Velasquez, who, later, as the court painter, exercised a powerful influence on the Madrid school; Alonso Cano (1610-67); Pedro de Moya (1610-66), a pupil of Van Dyck; and the greatest of all, Murillo, after whose death in 1682 the Seville school lost all its importance. The school of Madrid produced Luis Tristan (born in 1586); the two Carduchos, who were Florentines by birth; Juan de Paraja and Mazo Martinez, pupils of Velasquez; Antonio Pereda (1590-1669), who in his colouring excelled Murillo himself; Juan Careno de Miranda (born in 1614); Fr. Rizzi; Juan Antonio Escalante (1630-70); Claudio, Coello, &c. The common character of these two schools is an intelligent naturalism, sometimes reaching a very exalted degree of beauty, which is aided by bold design and composition, free from either caprice or arbitrariness, and a colouring somewhat too sombre in the shadows, but remarkable for its lustre and transparency, while its great softness places it in a middle position between the colouring of the Venetian school and that of the Neapolitan school. Painting took another direction in the school of Valencia, which experienced still more strongly the influence of Italy. The most celebrated masters of this school were Francisco Ribalta (1551-1628) and his pupils Pedro Orvete (born in 1550) and Jose Ribera, called Spagnoletto (1588-1656), who afterwards became the chief of the school of Naples. Spanish painting after this rapidly sunk to decay, but has experienced a partial revival through the not very healthy influence of the classicism of the French school. Among the more prominent of recent artists may be mentioned Vicente Lopez y Portana; Jose and Frederico Madrazo y Agudo; Juan Antonio and Carlos Luis Ribera; Esquirel, a portrait and historical painter; Genaro Perez Vilamil, a remarkable landscape-painter (died in 1854); Pedro Kuntz, who excels in perspective; &c. The Exposition universelle of 1867 contained a number of impor-

tant works by Spanish painters of good promise. But the one Spanish artist who in modern times has attained a world-wide reputation was Fortuny (born 1839, died 1874), a brilliant and original painter.

SPALATRO, or SPALATO, a seaport of Austria, in Dalmatia, beautifully situated on a bay of the Adriatic, 100 miles south-east of Zara. It is an ancient place, which rose to magnificence under the Romans, and was long in the possession of the Venetians. The most remarkable edifice is a vast palace, built by the Emperor Diocletian after his abdication, and still in tolerable preservation. The whole town was at one time confined within the precincts of the palace, and most of the buildings connected with it have been converted into private houses or public edifices. Among the latter are the cathedral, formerly the Temple of Jupiter, and its baptistery, formerly the Temple of Esculapius. The manufactures are chiefly tallow and wax candles, rosoglio, and brandy. The trade, which has the advantage of an excellent harbour, is large, and is carried on chiefly with Turkey, to which it sends smoked and salt provisions, oil, wine, leather, silk, and woollen stuffs. Pop. (1890), 22,716.

SPALDING, a market-town in the county of Lincoln, England, situated in a fine agricultural district, on the left bank of the Welland, 34 miles S.E. of Lincoln, has an old and spacious church, with a fine tower and spire; two other new churches, a Free Church of England, and several places of worship for Dissenters; a free grammar-school, of which the learned Dr. Bentley was for a time headmaster; a Blue-coat school, and a set of almshouses; a corn exchange, sessions-house, gentleman's club, Christian association, mechanics' institute, jail, and spacious market-place; also a cemetery and water-works. The river has been made navigable to the town for vessels of from 50 to 70 tons burden. A moderate trade is carried on with London, Hull, Lynn, and other places. A large business is done in wool, corn, coal, and timber. The Great Northern Railway passes near the town. Pop. (1901), 9385.

SPALLANZANI, LAZARUS, an eminent naturalist, was born at Scandiano, in Italy, in 1729, and studied at Reggio and afterwards at Bologna, under Laura Bassi, the celebrated female professor of physics in that place. In 1754 he was appointed teacher of logic, metaphysics, and Greek at Reggio. In 1760 he accepted a professorship at Modena, refusing, for family reasons, several more advantageous offers elsewhere. On the reconstruction of the University of Pavia, in 1768, he was appointed to the chair of natural history there, and thenceforth devoted himself to experimental researches, which he pursued for many years with assiduity, and published in Italian various works on physiology, which made his name known through Europe. Among the subjects which chiefly engaged his attention were the phenomena of generation, the functions of respiration, digestion, and the circulation of the blood. In opposition to the opinion of Buffon, which was adopted by Needham, he proved that the Infusoria are really endowed with animal life, and not merely organic molecules. In 1779 he travelled through the Swiss cantons; in 1785 he made a voyage to Constantinople, Corfu, and Cerigo; and in 1788 journeyed through the Two Sicilies and part of the Apennines, to collect volcanic products for the museum at Pavia. This celebrated naturalist died of apoplexy in 1799. Among the numerous writings of Spallanzani are *Experiments on Animal Reproduction*; on *Infusory Animalcules*; on the *Phenomena of Circulation*; on *Animal and Vegetable Physics*; *Travels in the Two Sicilies*; on the *Transpiration of Plants*. A complete catalogue of his

works, many of which have been translated into English, will be found at the end of his life in vol. vii. of the *Biographie Médicale*.

SPANDAU, a town in Prussia, in the province of Brandenburg, 12 miles north of Potsdam, at the confluence of the Spree and Havel. It is a fortress of the first rank and forms an important portion of the defences of Berlin. It has a strong citadel situated on an island of the Havel, with a tower in which is kept the imperial war treasure of Germany, amounting to £8,000,000 sterling. It has government manufactures of artillery and small-arms, gunpowder, &c., employing some 4000 workers; also breweries and distilleries, ship-yards and some shipping, and general trade. Spandau is a very old town. It received municipal privileges in 1232. Its fortifications were erected by Count Rochus von Lynar between 1577 and 1583. On the 6th of May, 1631, the elector George William surrendered it to the Swedes, who occupied it till 1635. On the 25th of October, 1806, it opened its gates to the French, who remained in possession of it till the 26th of April, 1813. Pop. in 1895, 55,841; in 1900, 65,014.

SPANDREL, or SPANDEIL, in architecture, an irregular space on a wall bounded by the outer curve of an arch, and two lines meeting at right angles, the one drawn perpendicularly from the springing of the arch, and the other horizontally from the apex, or by the outer curves of two contiguous arches and a horizontal line above them, or by similar curves of contiguous arches and the line of a larger arch inclosing the other two.

SPANGLES, metal ornaments, used chiefly for theatrical dresses, and consisting for the most part of thin circular pieces of gilt or silvered tin, with holes through them, enabling them to be sewed on cloth.

SPANIEL, the name given to various races of dogs, which are generally divided into the two groups of Sporting and Toy Spaniels. The Field or Common Spaniel is the type of the group, and two breeds of this variety, respectively named the 'Springer' and 'Cocker' breed, are distinguished. The latter derives its name chiefly from being used in woodcock shooting. The former is a heavier dog, and is used for beating game in thick coverts. From the Cockers the Blenheim and King Charles spaniels are derived. The spaniel has the hair very long in some parts; it is generally white, with large brown, liver-coloured, or black spots, of irregular shape and size; the nose is sometimes cleft; the ears are very long and pendulous, and covered with long hair. This race came originally from Spain, whence its name. The Setter is sometimes called the *English Spaniel*. It corresponds in every point with the true spaniel, but is trained more particularly for field sports. The tail presents a marked feature in these dogs, in that it is feathery in shape, and is waved from side to side when the dog runs. A famous breed of Springer Spaniels is a black Sussex breed, and the 'Clumber' breed is also well known. The latter includes heavily-built dogs, which may attain a weight of from 30 to 40 lbs. The Cocker is much smaller than the Field Spaniel. The best-known breeds of the latter form are the English, Welsh, and Devonshire varieties. The smaller or King Charles spaniel is a small variety of the spaniel, used as a lap-dog. It is sometimes found entirely black, and receives its name from the liking of Charles II. for this variety.

The Water Spaniels are dogs of moderate size, and average about 22 inches in height at the shoulders, and the ears are very long and pendulous. The Blenheim breed of spaniels is of smaller size than the King Charles variety, and is bred merely as a pet. The hair of the Blenheim Spaniel is long and

silky, and does not curl; the ears are long, and provided with the same silky hair; the legs are covered with this hair to the toes; and the tail possesses a broad hairy fringe. The Maltese Dog and the Lion Dog are generally included among the Spaniels. The first is supposed to have sprung from the intercourse of the Little Spaniel with the smaller Water-dog. It has the hair, all over the body, very long and silky, and generally pure white. The other has long silky hair about the head, neck, shoulders, and extremity of the tail, but on the other part short, giving the little animal a leonine appearance. It is probably bred between the Little Spaniel and one of the naked varieties.

**SPANISH FLY.** See CANTHARIDES.

**SPANISH MAIN**, the Atlantic Ocean and coast along the north part of South America, from the Leeward Islands to the Isthmus of Darien.

**SPANISH SUCCESSION, WAR OF THE**, a war which broke out in 1701 on the death of Charles II. of Spain, and was terminated by the peace of Utrecht in 1713. See SUCCESSION WARS.

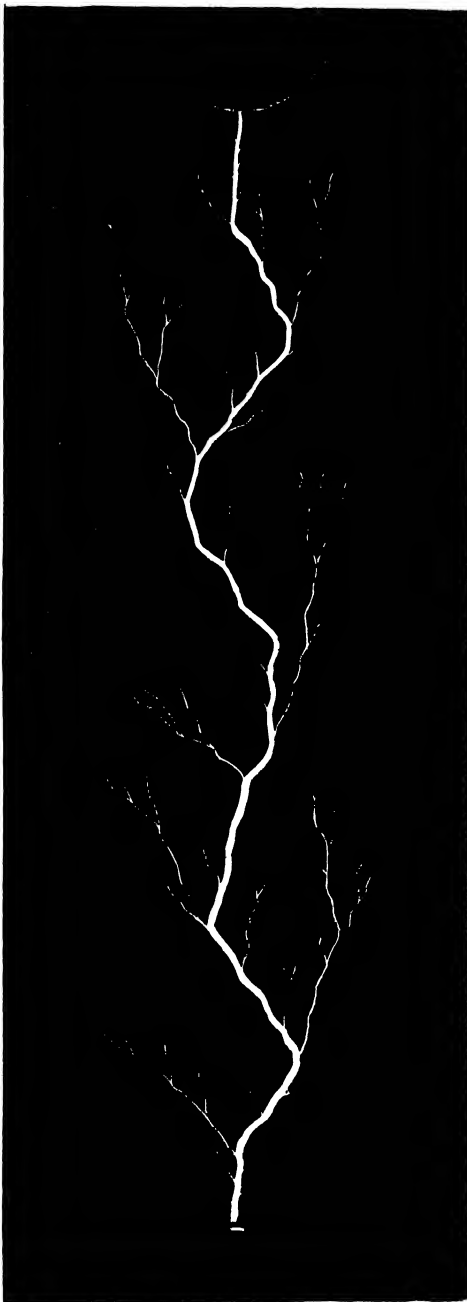
**SPANISH TOWN**, or SANTIAGO DE LA VEGA, a town in Jamaica, on the south side of the island, about 12 miles north-west of Kingston. It was formerly the seat of government, but since 1872 Kingston has held that position. It is ill built and unhealthy. Pop. (1891), 5689.

**SPARK, ELECTRIC**, a discharge of electricity which is accompanied with light and violence. If the knuckle is presented to the conductor of an electric machine in working order, a spark will pass between the conductor and the knuckle, producing a sharp crack, and sensibly stinging the finger. If the machine is a large one an electric shock will be felt. A number of important phenomena may be described and explained under the heading of electric spark. When two portions of matter differ in their electrical conditions—that is, when one portion is at a higher potential than the other—then a certain amount of work may be done by their coming to the same potential; and when this work is performed on a small mass of matter that matter is very intensely heated, and gives out light and sound. Short sparks are straight, the path is direct from the one electrified body to the other; but, as may be seen from fig. 1, and as is sometimes seen in lightning, where the distance is considerable compared with the quantity of electricity involved, the path is branched and zigzag, owing to conducting particles of dust, which act as stepping-stones, in the case of the artificial spark, and to intermediate masses of cloud or aqueous vapour in the case of lightning. Nearly all the experiments which may be performed with electrical machines are experiments with the electric spark; and many fanciful pieces of apparatus have been constructed, such as the sparkling pane, &c., by which the spark is multiplied to produce beautiful or curious effects.

When a spark is passed through dry gunpowder the air is intensely heated and the gunpowder is scattered, because the expansion of the air is too sudden to allow of the heat affecting the gunpowder; but if the spark is passed through a damp string laid across the gunpowder an explosion of the gunpowder occurs. Minnersley's thermometer (fig. 2) is designed to show the violence and heat produced by the spark in air. The small tube of the instrument is open at the top, and communicates below with the larger tube, which is close; a spark from a Leyden-jar is made to pass between the two knobs, which may be seen inside the large tube, and the violence of the action drives the water, seen occupying the lower part of the tubes, up the small tube to a considerable height (several yards, if the spark is very strong). Wheatstone employed the revolving

mirror to measure the duration of the spark. It is to be understood that the duration of the spark depends on the circumstances. The arc electric light is produced by a series of sparks between two charcoal

Fig. 1.

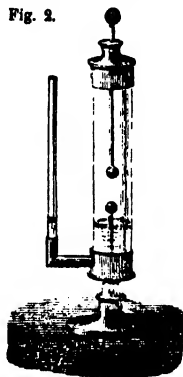


points. The colour of the spark depends on the matter through and by which the discharge takes place. When sparks are taken between two metallic points a short distance apart, the colour is nearly altogether due to the metal of which the points are

composed, but when the distance is considerable the colour in the interval between the points is due to the air or medium through which the sparks pass.

It is found on passing sparks through a gas that, as the gas is rarefied, sparks pass more freely till a certain limit is reached, when sparks will not pass, so that a vacuum is absolutely non-conducting. Some beautiful apparatus are now sold under the name of Geissler's tubes, which illustrate the passage of the spark through rarefied gases. With Geissler's tubes a Ruhmkorff's coil is usually employed to give the sparks. The glowing gas appears stratified at right angles to the direction of the spark, and gives the idea of nodes and ventral segments, as if pulsations were conveyed by the gas.

Fig. 2.



The series of sparks through a tube of rarefied gas is seen to be affected by a magnet as a current free to move is affected by a magnet; and when sparks are passed through an exhausted oval glass shell having a magnet up its centre, the lines along which the currents run will be seen to revolve round the magnet.

**SPARROW** (*Passer*), the name given to several Insectorial Birds belonging respectively to the Conirostral and Dentiostiral groups of that order. The familiar Sparrow (*Passer domesticus*) thus belongs to the Conirostral sub-family of the Fringillinae or True Finches; whilst the Tree Sparrow (*P. montanus*) and the White-throated Sparrow of America (*Zonotrichia albicollis*) are also included in that sub-family. The Hedge-sparrow or Hedge-warbler (*Acceator modularis*), on the other hand, belongs to the Dentiostres, and is allied to the Redbreast and other Warblers (Sylviidae). (See **HEDGE-WARBLER**.) The name Java Sparrow is given to the Rice-bird or *Oryzornis oryzivora*, also belonging to the Fringillidae or Finch family, and described in the article **BIRD**. The genus *Passer*, to which our familiar sparrows belong, is distinguished by the bill being broad at its base, and slightly scooped at its tip. The nostrils are partly concealed by the feathers, and the wings have their second and third quills longest. The tail is of moderate size. The Common Sparrow has the top of the head coloured of a slaty-gray; the throat is black, and the latter colour passes over the eyes from the base of the head. The upper parts generally are brown, marked with black, each feather exhibiting a black centre. The smaller wing-coverts may be marked with white, the breast is grayish-brown, and the under parts a dirty white, inclining to brown. Sometimes black, pied, brown, or even white varieties are seen. The average length of this species is 6 inches. In habits no birds are more active or fearless than the Common Sparrows. They mingle freely with man, and closely attend the busiest haunts of trade for the purpose of picking up food. They are alike denizens of the country and the town—the coloration of the town sparrows being generally of a dingier hue than that of their country neighbours. The food consists of insects and grain, and these birds are highly useful to agriculturists in their raids on destructive insect larvæ. The nest is rudely constructed of hay, straw, leaves, &c., and is usually found in old walls, in house-crevices, and more rarely in trees. The eggs number five or six, and are coloured of a dull white, marked with brown. These birds are very prolific, and may bring up several

broods in one year. The Tree Sparrow is known by its chestnut-coloured head, by the cheeks possessing a black patch of triangular shape, and by the belly being of a brownish-white colour. This latter species is by no means so familiar or common as the preceding. The nest is generally built in trees, the eggs numbering four, five, or six, and being of a dull white colour, spotted with brown. The neck may be encircled with a white streak, and the lower wing-coverts are black. The average length is from  $4\frac{1}{2}$  to  $5\frac{1}{2}$  inches. The White-throated American Sparrow possesses its upper surface variously coloured with black, ashy-brown, and dark-brown colours—the chin, breast, and under parts being pure white. The head exhibits black and white stripes, and the space between the eye and nostril is orange-yellow. The female possesses a lighter breast than the male. The bill is of slaty colour, and the legs are of a flesh-coloured hue. This bird attains an average length of  $6\frac{1}{2}$  inches. It appears to be migratory in habits, and to pass from the north to the south of the New World on the approach of winter. It is found in most of the Southern States of North America, and is the largest and handsomest of the American Sparrows.

**SPARROW-HAWK** (*Accipiter nisus*), a species of Raptorial Birds forming the type of the sub-family Accipitrinae, and one of the most common of British Hawks. The sub-family is distinguished by the short, strongly-arched bill, by the long wings and tail, and by the elongated tarsi covered with large scales or *scute* in front. The genus *Accipiter* is well represented in every part of the world. The Sparrowhawk itself attains an average length of 12 inches, the females being a little larger than the males. The male is coloured dark brown on the top of the head, and on the upper aspect of the body and wings. In old birds the brown tint assumes a grayish hue. The under parts are of a reddish-brown colour, marked with narrow bands of darker tint. The legs and claws and cere are yellowish; the bill being of a slaty-blue colour. The female bird is of a duller brown hue on the back and head, and her plumage is diversified by numerous white spots. The tail and primary wing-quills are of light-brown hue covered with cross-bars of black; and the same markings are seen on the under surface, which itself is gray. The nest is built generally in some high situation. The eggs number three or four, and are coloured grayish white, tinged with blue, and marked with dark-brown in an irregular manner. Very frequently the Sparrowhawk takes possession of the deserted nest of a crow or some other bird. In habits these birds are bold and active. Not unfrequently the Sparrowhawk may be seen to attack other and larger birds of prey, its courage extending even to a reckless degree, whilst it is also shy and wary. Occasionally these birds would appear to exhibit a marked degree of terror, and seem terrified at their surroundings; this being specially marked in those Sparrowhawks which have been attempted to be trained to falconry. In some cases the boldness of this bird leads it into danger, as it may be literally 'mobbed' by hosts of smaller birds—such as swallows, &c., and be pecked to death; although even when thus surrounded a Sparrowhawk has been seen to seize a victim from among the crowd and bear it away in triumph. The name American Sparrowhawk is given to a bird of the genus *Falco* (*Falco sparverius*), found in the New World.

**SPARTA**, or **LACEDÆMON** (now *Sparti*), a celebrated city of ancient Greece, the capital of Laconia and of the Spartan state, lay on the west bank of the river Eurotas, and embraced a circuit of 48 stadia or 6 miles. Sparta was irregularly built, and from

this circumstance it is supposed to have got its name, signifying 'scattered.' It consisted of five separate quarters, which were not protected by any general system of fortifications till the time of Nabis, in the beginning of the second century B.C., and were not completely surrounded by walls till the time of the Romans. It was the boast of Sparta that her men were her walls. Among other remarkable objects enumerated by Pausanias are the following: the market-place (*agora*), containing the public buildings, in which the council of the elders (*Gerousia*) and the *Ephori* held their meetings, and the principal ornament of which was the Persice, a celebrated colonnade, built from the spoils taken from the Persians; its roof was supported by statues of Persians; the theatre (near the market-place), the remains of which constitute the principal ruins of Sparta; the *chorus*, or place in which the ephēbi executed their dances, adorned with statues of Apollo, Artemis, and Leto; the *Leschai*, or halls in which the popular assemblies were held, and of which there were two—the *Lesche* of the *Crotanes*, near the tombs of the *Agides*, and the *Lesche Pœcile*; the Temple of *Athean Polionchos* or *Chalkioikos*, as the goddess was commonly called, from the bronze ornaments of her temple, on a steep hill, to which the Spartans gave the name of the *Acropolis*; &c. Sparta was the name of the city during the period of its historical celebrity. *Lacedæmon* is found in Homer as the name both of the city and the territory, but it afterwards dropped out of use, and does not appear to have been revived till several centuries after Christ.

LACONIA, the district in which Sparta was situated, was the south-eastern division of the Peloponnesus, bounded on the west by Messenia, from which it was separated by the chain of Taygetus (now *Pentadaktylon*, 'five fingers'), on the north by Arcadia and Argolis and on the east and south by the sea. The *Eurotas* (*Vasilopotamo*, 'king of rivers') here empties into the Gulf of Laconia, the western shore of which terminates in Cape *Tænarus* (*Matapan*), and the eastern in Cape *Malea* (*St. Angelo*). These two capes form the extremities of two mountain chains running nearly parallel to one another from north to south, and inclosing between them the valley of the river above mentioned. One of these ranges is the chain already named, and the other was called *Parnon* (now *Malevos*). In the Taygetus range the highest peaks are about 7900 feet high, in that of *Parnon* the highest (in the north-east) are about 6300. The valley between is pretty largely intersected by spurs from the two ranges, so that the level parts are few and small. The principal towns in Laconia besides Sparta were *Amyclæ* and *Pharis*, both situated like Sparta on the west bank of the *Eurotas*, a little lower down.

According to fable, *Lacedæmon*, son of Zeus, and of the nymph *Taygeta*, married Sparta, daughter of *Eurotas*, king of the *Leleges*, succeeded his father-in-law on the throne, and gave the country his own name, calling the city by that of his wife. Among celebrated early kings was *Tyndareus* or *Tyndareüs*, with whose sons *Castor* and *Pollux* the male line of *Lacedæmon* became extinct. *Menelaus*, from whom and *Lacedæmon* five kings had reigned, married *Helen*, the daughter of *Tyndareus*, and thus acquired the throne. *Orestes*, son of *Agamemnon*, who had married *Hermione*, the daughter of *Menelaus*, united *Argos* and *Mycenæ* with *Lacedæmon*. In the reign of his son and successor *Tisamenus*, it was conquered by the *Heraclidæ* about 1080, who established a dyarchy or double dynasty of two kings in Sparta. For as neither the mother nor the Delphic oracle could decide which of the twin sons of *Aristodemus*, *Eurysthene*s and *Procles*, was first born, the

province of Laconia was assigned to them in common; and it was determined that the descendants of both should succeed them. The *Lacedæmonians*, however, had little cause to rejoice at the arrival of the foreigners, whose fierce disputes, under seven rulers of both houses, distracted the country with civil feuds, while it was, at the same time, involved in constant wars with its neighbours, particularly the *Argives*. The royal authority was continually becoming feebler, and the popular power was increased by these divisions, until the government ended in an ochlocracy. At this time *Lycurgus* was born, for the healing of the troubles. He was the only man in whom all parties confided, and under the auspices of the gods whose oracle he consulted he established a new constitution of government in Sparta (about 880 B.C.), and thus became the saviour of his country.

Such is the legendary account of the early history of Sparta. All that is actually accepted as historical in it is the fact that the Spartans were the descendants of the *Dorians* who invaded the Peloponnesus about eighty years after the siege of Troy (according to the common account), and that from an early period they followed a set of rigorous institutions aimed at forming them into a purely warlike nation. These institutions they themselves ascribed to *Lycurgus*, who, if he was really a historical character, must have lived not later than the ninth century. Shortly after their settlement in the Peloponnesus it is probable that the Spartans extended their sway over all the territory of Laconia, the inhabitants of which they reduced partly to the condition of *Helots* and partly to that of *Periœci*. The former were completely enslaved, bound to the land which they had to till for their masters, and required to serve the state in war. The latter were free, possessing land of their own, and carrying on trade and practising the arts, both of which pursuits were forbidden to Spartans. The next great wars of Sparta are usually regarded as the direct consequence of their new institutions. They were waged with the *Messenians* in the eighth and seventh centuries B.C., and resulted, in 668 B.C., in the complete subjugation of the *Messenians*, who were either compelled to leave their country or reduced to the condition of *Helots*. (For details, see *MESSENIA*.) Wars were also carried on against their northern neighbours, the *Arcadians* and the *Argives*, against both of whom they were successful, and before the close of the sixth century B.C. they not only stood at the head of the states of the Peloponnesus, but were even recognized as the leading people in all Greece. Early in the following century began the Persian wars, in which Sparta played a conspicuous part, but the details of this epoch down to the conclusion of the Peloponnesian war in 404 B.C. belong to the common history of Greece, to which the reader is accordingly referred. It is enough to state here that the events of the wars with Persia led to Sparta being supplanted by Athens as the leading state in Greece; that there hence arose a jealousy between the two cities which ultimately brought on a war, in which the one half of Greece was divided against the other, and that this war, the Peloponnesian, ended in the ascendancy of Sparta and the entire humiliation of her rival. The rivalry of the Spartan general *Lysander* and the king *Pausanias* soon after produced a revolution, which delivered the Athenians from the Spartan yoke (403). Soon after the Spartans became involved in a war with Persia, by joining *Cyrus the Younger* in his rebellion against his brother *Artaxerxes Mnemon* (401). The war was continued even after the failure of the enterprise of *Cyrus*, and the Persian throne was shaken by the victories of *Agessians*; but Athens, Thebes, Corinth, and some of the Peloponnesian

states, were instigated by Persian gold to declare war against the Lacedæmonians, who found it necessary to recall Agesilaus. The latter defeated the Thebans at Coronea (394); but, on the other hand, the Athenian commander, Conon, had a few days previously gained a victory over the Spartan fleet at Cnidus, and took fifty galleys. This war, known as the Bœotian or Corinthian war, lasted eight years, and increased the reputation and power of Athens by the successes of her admiral, Conon, and her fortunate expeditions against the Spartan coasts and the islands of the Ægean. To break the alliance of Athens with Persia, Sparta, in 387 B.C., concluded with the latter power the peace known by the name of Antalcidas, in which it sacrificed the liberty of all the Asiatic Greeks. The ambitious designs of Sparta in concluding this peace soon became apparent: she continued to oppress her allies, and to sow dissensions in every quarter, that she might have an opportunity of acting as umpire. Besides other outrages, she occupied, without provocation, the city of Thebes, and introduced an aristocratical constitution there. Pelopidas delivered Thebes, and the celebrated Theban war (378-363) followed, in which Sparta was so much enfeebled that she thenceforward ceased to act a distinguished part in Greece. No state was strong enough to take the lead, and the Macedonian king, Philip, at last made himself master of all Greece (338). After the death of Philip, Agis III., king of Sparta, one of the bravest and noblest of its princes, ventured to maintain a struggle for the liberties of Greece; but he lost his life in the battle of Megalopolis against Antipater, who had been left governor of Greece by Alexander the Great (331). During the following century Sparta steadily declined, although one or two isolated attempts were made by its rulers to restore it to its former greatness. The principal of these attempts was made by Cleomenes (236-222), who aimed not only at the restoration of the ancient Lyncurgian institutions, which had fallen into complete neglect, but also at the re-elevation of Sparta to a position of supremacy in the Peloponnesus. In both endeavours he failed, and it could not have been otherwise. The Sparta of his day hardly resembled in any respect the Sparta to which Lyncurgus is said to have given laws. Instead of the 8000 or 9000 Spartans of the time of Lyncurgus, there were now scarcely 700 of Spartan descent, and the majority of these were in a state of beggary; while the inhabitants of Sparta, whether of Spartan descent or not, were utterly corrupt. The reforms of Cleomenes did not survive his own reign, which terminated with his defeat by the Achæan League at Sellasia in 222. With the rest of Greece Sparta ultimately passed under the dominion of the Romans. See GREECE.

The Spartans were distinguished among the people of Greece by their manners, customs, and constitution. Their kings (two of whom always reigned at once) ruled only through the popular will, as they had no other privileges than those of giving their opinion first in the popular assemblies, acting as umpires in disputes, and of commanding the army; their only other advantages were a considerable landed estate, a large share of the spoils, and the chief seats in assemblies and at meals. The Spartans, that is, the descendants of the Dorians, who acquired possession of Laconia under the Heræclids, were occupied only with war and the chase, and left the agricultural labours to the Helots; but the Laconians, or Pericæi (the ancient inhabitants of the country), engaged in commerce, navigation, and manufactures. Although the Spartan conquerors were superior in refinement and cultivation to the Laconians, the arts of industry flourished only among the latter. They gradually intermingled with the Spartans, whom they exceeded

in number, and formed one people. Herodotus states the number of Spartans at only 8000. Both peoples constituted one state, with a national assembly, to which the towns sent deputies. The military contributions in money and troops formed the principal tribute of the free Laconians to the Spartans (Dorians). The former were sometimes divided by jealousy from the latter, and in the Theban war several towns withdrew their troops from the Spartans and joined Epaminondas. The distinguishing traits of the Spartans were severity, resolution, and perseverance. Defeat and reverse never discouraged them. But they were faithless and crafty, as appears from their conduct in the Messenian wars, in which they not only bribed the Arcadian king, Aristocrates, to the basest treachery towards the Messenians, but also corrupted the Delphic oracle, of which they made use to the prejudice of the Messenians. The age at which marriage might be contracted was fixed by Lyncurgus at thirty for men and twenty for women. When a child was born, if it proved vigorous and sound the state received it into the number of citizens, otherwise it was thrown into a cave on Mount Taygetus. The Spartan children were early inured to hardships and accustomed to freedom. To accustom them to endure hunger they gave them but little food; and if they stood in need of more they were obliged to steal it; and if discovered, they were severely punished, not for the theft, but for their awkwardness. Every ten days they were required to present themselves before the ephori, and whoever was found to be too fat received a flogging. Wine was not generally given to girls in Greece, but was commonly allowed to boys from earliest childhood. In Sparta the boys were obliged to wear the hair short until they attained the age of manhood, when it was suffered to grow. They usually ran naked, and were generally dirty, as they did not bathe and anoint themselves like the other Greeks. They took pride in having the body covered with marks of bruises and wounds. They wore no outer garment except in bad weather, and no shoes at any time. They were obliged to make their beds of rushes from the Eurotas. Till the seventh year the child was kept in the gynæceum, under the care of the women; from that age to the eighteenth year they were called boys (*protêres*), and thence to the age of thirty, youths (*ephêboi*). In the thirtieth year the Spartan entered the period of manhood, and enjoyed the full rights of a citizen. At the age of seven the boy was withdrawn from the paternal care, and educated under the public eye in company with others of the same age, without distinction of rank or fortune. If any person withheld his son from the care of the state he forfeited his civil rights. The principal object of attention during the periods of boyhood and youth was the physical education, which consisted in the practice of various gymnastic exercises—running, leaping, throwing the discus, wrestling, boxing, the chase, and the *pancratium*. These exercises were performed naked, in certain buildings called *gymnasia*. Besides gymnastics, dancing and the military exercises were practised. A singular custom was the flogging of boys (*diastasiyoria*) on the annual festival of Artemis Orthia, for the purpose of inuring them to bear pain with firmness: the priestess stood by with a small, light, wooden image of Artemis, and if she observed that any boy was spared she called out that the image of the goddess was so heavy that she could not support it, and the blows were then redoubled. The men who were present exhorted their sons to fortitude, while the boys endeavoured to surpass each other in firmness. Whoever uttered the least cry during the scourging, which was so severe as sometimes to prove fatal, was considered as disgraced, while he who bore

It without shrinking was crowned, and received the praises of the whole city. According to some, this usage was established by Lycurgus; others refer it to the period of the battle of Plataeæ. To teach the youth cunning, vigilance, and activity, they were encouraged, as has been already mentioned, to practise theft in certain cases; but if detected they were flogged, or obliged to go without food, or compelled to dance round an altar singing songs in ridicule of themselves. The fear of the shame of being discovered sometimes led to the most extraordinary acts. Thus it is related that a boy who had stolen a young fox, and concealed it under his clothes, suffered it to gnaw out his bowels, rather than reveal the theft by suffering the fox to escape. Swimming was considered among the Spartans to be so indispensable that it was a proverb among them, to intimate that a man was good for nothing—He cannot even swim. Modesty of deportment was also particularly attended to; and conciseness of language was so much studied that the term *laconic* is employed to signify a short, pithy manner of speaking. The Spartans were the only people of Greece who avowedly despised learning, and excluded it from the education of youth. Their whole instruction consisted in learning obedience to their superiors, the endurance of all hardships, and to conquer or die in war. The youth were, however, carefully instructed in a knowledge of the laws, which, not being reduced to writing, were taught orally. The education of the females was entirely different from that of the Athenians. Instead of remaining at home, as in Athens, spinning, <sup>and</sup> they danced in public, wrestled with each other, ran on the course, threw the discus, &c. This was not only done in public, but in a half-naked state. The object of this training of the women was to give a vigorous constitution to their children.—See Miller's *History and Antiquities of the Doric Race*, translated, with additions, from the German (London, 1830). The Mainotes have been supposed to be the descendants of the ancient Spartans. See MAINOTES.

SPARTACUS, a Thracian gladiator, the instigator of the servile war or revolt of the slaves in Italy. He had been compelled, like other barbarians, to serve in the Roman army, from which he had deserted, and at the head of a body of chosen companions had carried on a partisan war against the conquerors. Being made prisoner Spartacus was sold as a slave; and his strength and size caused him to be reserved as a gladiator. He was placed in a gladiatorial school at Capua with 200 other Thracian, German, and Gaulish slaves, among whom a conspiracy was formed (B.C. 73) for effecting their escape. Their plot was discovered; but a small body under Spartacus broke out, and having procured arms and gained some advantages over the Roman forces sent against them, they were soon joined by the slaves and peasantry of the neighbourhood, and their numbers amounted to 10,000 men. By the courage and skill of Spartacus several considerable battles were gained; but his authority was insufficient to restrain the ferocity and licentiousness of his followers, and the cities of the south of Italy were pillaged with the most revolting atrocities. In a few months Spartacus found himself at the head of 60,000 men; and the consuls were now sent with two legions against the revolted slaves. Mutual jealousies divided the leaders of the latter, and the Gauls and Germans formed a separate body under their own leaders, while the Thracians and Lucanians adhered to Spartacus. The former were defeated, but Spartacus skillfully covered their retreat, and successively defeated the two consuls (72 B.C.) Flushed with success his followers demanded to be led against Rome; and the city trembled before the servile forces. In

this crisis Licinius Crassus, who was afterwards a triumvir, was placed at the head of the army. His lieutenant Mummius, whom he despatched with two legions to watch the motions of the enemy, was defeated by a superior force, and slain. Crassus, after having made an example of the defeated legions by executing every tenth man, surrounded Spartacus near Rhegium with a ditch 6 miles in length. Spartacus broke through the enemy by night; but Crassus, who did not doubt that he would march upon Rome, pursued him, and defeated a considerable part of his forces, who had abandoned their general from disaffection. Spartacus now retreated, but his followers compelled him to lead them against the Romans. His soldiers fought with a courage deserving success; but they were overcome after an obstinate conflict, and Spartacus himself fell fighting on his knees upon a heap of his slain enemies. According to the Roman statements 60,000 rebels fell in this battle, which was fought on the river Silarus, in Lucania, in 71 B.C. 6000 were made prisoners, and crucified on the Appian Way. A considerable number escaped and continued the war, but they were finally destroyed by Pompey.

SPASM, a violent and usually painful contraction of muscular fibres. It is either tonic or clonic. In the former case the contraction is prolonged, and the relaxation takes place slowly. In the latter case the contractions and relaxations occur in quick succession, constituting what is generally known as convulsions, such as take place in St. Vitus' dance, epilepsy, and convulsive hysteria. Spasm may affect either the voluntary or the involuntary muscles. Spasm affecting the voluntary muscles is sometimes distinguished by the name of cramp; but this name is applied by other medical authorities to all cases of tonic spasm, whatever muscles may be affected. The principal cases of spasm of the involuntary muscles are, spasm of the stomach, of the bowels (colic), of the bile ducts (biliary colic), or urinary ducts (renal colic), occurring during the passage of a stone. In all cases of tonic spasm heat is one of the best remedies and is certainly the safest.

SPATHE (Greek, literally, 'a broad-bladed sword'), a foliaceous envelope, often of great size, inclosing and protecting the inflorescence of many monocotyledonous plants. The flowers inclosed within a spathe are often arranged in a thick cluster round or at the end of a succulent spike called a spadix. The spathes that envelop the spadix of the arums and the palms, the flowers of the iris and narcissus, and the inflorescence of onions, are bracts of a thick and sometimes even coriaceous texture. The spathe of some kinds of palms is almost woody and strong enough to be used as a water vessel, and even as a bath for children.

SPAVIN, a disease of horses, affecting the hock-joint, or joint of the hind leg, between the knee and the fetlock, corresponding to the ankle in man. It occurs in two forms. In the first, which is called bog or blood spavin, the joint is distended by joint-oil (synovia). In the other form there is a morbid deposition of bony substance, such as to unite separate bones. In both forms of the disease rest is necessary for a cure. The latter form is often incurable.

SPAWNING OF FISHES. In the oviparous fishes, with distinct sexes, the eggs are impregnated externally, and arrive at maturity without the aid of the mother. The spawn being deposited by the female, the male then pours upon it the impregnating fluid. In the ovoviviparous fishes, or those (such as the Blennies, &c.) in which the eggs are retained within the parent-body until they are hatched, sexual intercourse in some form takes place, and the eggs

are hatched in the uterus. In the Sharks, Rays, &c., the act of impregnation is assisted by the presence in the males of peculiar organs termed 'claspers', by means of which the male retains hold of the body of the female during the performance of the sexual act; and the eggs are enclosed each within a special capsule of horny matter, the 'mermaids' purses' of the sea-coast. The season of spawning varies according to the species and even the habits of the individual. In general, before spawning, fish forsake the deep water and approach the shore, and some forsake the salt water and ascend the rivers, and after spawning return again to the ocean. The eggs of various species of fish are used as articles of food. *Caviare* consists of the prepared roe of the sturgeon.

**SPEAKER.** The lord-chancellor is, *ex officio*, the speaker of the British House of Lords, and may, if a lord of parliament, as in practice is always the case, give his opinion and argue any question before the house. There is also a deputy-speaker of the House of Lords appointed by the crown. In the absence of both the lord-chancellor and his deputy the House of Lords may elect any one of their own number to fill their place for the occasion. The speaker of the House of Lords has no casting-vote, since the rule of that body is that in cases of numerical equality in voting the non-contents prevail. The speaker of the House of Commons is a member of the House, elected by a majority of the votes to act as chairman or president in putting questions, reading briefs or bills, keeping order, reprimanding the refractory, adjourning the house, &c. He is the official representative of the house, and on entering and leaving the house has the mace carried before him by the sergeant-at-arms, and as long as a sitting lasts the mace lies on a table before him. The mace also accompanies him on all state occasions. The first thing done by the Commons upon the meeting of a Parliament is to choose a speaker, who is to be approved of by the crown. The speaker is not allowed to persuade or dissuade in passing a bill, except in committee of the whole house, but only to make a short and plain narrative; nor to vote, unless the house be equally divided, when he has a casting-vote. He receives a salary of £5000 a year, with a furnished residence. He is a member of the privy council, and ranks after the barons. On vacating his post he receives a pension of £4000 and is raised to the peerage. The first time a speaker was appointed by this title was in the reign of Edward III, when Sir T. Hungerford was elected. In 1853 it was provided that, in the unavoidable absence of the speaker, the chairman of the committee of ways and means should act as his deputy; and this provision was confirmed by act of Parliament in 1855. In the United States this title is given to the presiding officer of the House of Representatives and of the lower houses of state legislatures.

**SPEAKING TRUMPET**, a metallic instrument of a somewhat conical form used for conveying the sound of the voice to a distance. The advantage of the conical form is satisfactorily explained on the assumption that waves of sound are reflected in the same way as rays of light, the angle of incidence and the angle of reflection being the same; for on this assumption it is evident that waves of sound proceeding from the narrow to the wide end of a truncated cone, from the walls of which they are reflected according to the law referred to, will gradually make smaller angles with the axis of the cone; or in other words, the direction of the sound will gradually become more nearly parallel to that axis. A cylindrical tube of uniform diameter has not the same effect, and accordingly is of no use in determining the direction of sound after it leaves the tube,

although, as is seen in the case of *speaking-tubes* used in offices, industrial establishments, and private houses, it is of great service in transmitting sound from one extremity to the other. Speaking-trumpets are chiefly used at sea, especially in windy weather, to convey commands from one part of the ship to another, and sometimes to speak with another ship. An instrument of the same form as that still in use was invented about 1670 by Sir Samuel Morland, who directed the attention of the Royal Society to this instrument.

**SPECIAL LICENSE**, according to the marriage law of England a license granted by the Archbishop of Canterbury to authorize a marriage at any time or place that may be convenient to the parties. The right of granting such licenses was formerly claimed and exercised by the pope, but at the time of the Reformation was transferred to the Archbishop of Canterbury.

**SPECIAL PLEADERS**, members of an inn of court not called to the bar, who occupy themselves with the drawing of common law pleas, and attend at judges' chambers. They must take out an annual certificate at a cost of £9. In common speech a person is called a special pleader who states only one side of a case, persistently ignoring any other.

**SPECIES**, a group of individuals which agree in exhibiting certain distinctive hereditary characters of sufficient importance to render a particular name convenient. When we familiarly talk of the different 'kinds' of plants and animals, we indicate in a rough way the biological idea of species; and the recognition of rook and raven, juckdaw and carrion crow, as different kinds of crow corresponds with the scientific distinction of these as four different species of the genus *Corvus*. In many a case, however, where the distinctive hereditary characters are less conspicuous, the ordinary observer may see only one 'kind' where the trained naturalist detects many 'species'. Moreover, where a naturalist unfamiliar with the details of a particular class of animals might discern only half a dozen distinct species, the specialist may distinguish a score. In fact, the conception of species is entirely relative to convenience; where the 'lumpers' think a score of special groups with special names quite sufficient, the 'splitters' may think it necessary to distinguish a hundred. Except in cases where the limitations of group from group are very clear, as in the case of the four 'kinds' of crow above-mentioned, it requires a period of criticism before a satisfactory compromise between the 'lumpers' and the 'splitters' can be arrived at. And the reason for this is simply that in many cases one species is linked to another by intermediate varieties, and, it may be, also by hybrids. Thus, to keep to the genus *Corvus*, it is a matter for argument whether it is or is not scientifically convenient to distinguish the carrion crow (*Corvus corone*) from the hooded crow (*Corvus cornix*) as separate species, for they certainly interbreed, and every transition of plumage may be found between the two. An inspection of Mr. Seebohm's case of gradations in the Museum of Natural History at South Kensington will prove more convincing than many words.

Collections of definitions of 'species' have often been made; and the curious will find a score in Quatrefages' posthumous work, Darwin et ses Précurseurs Français. Thus, Linnaeus wrote: 'Species tot numeramus quot diversæ formæ in principio sunt creatæ'. Buffon defined species as 'a constant succession of individuals similar to, and capable of reproducing, each other'. De Candolle said that a species was 'an assemblage of all those individuals which resemble each other more than they do others, and which are able to reproduce their like, in such

a manner that they may be supposed by analogy to have descended from a single being or a single pair'. Quatrefages' idea of species is summed up in his statement that it is 'an assemblage of individuals more or less resembling one another, which are descended, or may be regarded as being descended, from a single pair by an uninterrupted succession of families'. Müller says species is a 'living form, represented by individual beings, which reappears in the product of generation with certain invariable characters, and is constantly reproduced by the generative act of similar individuals'. These illustrations may suffice to impress the fact that the *invariable* nature of species had become firmly fixed on the minds of the older naturalists in former years.

But since Darwin and his compeers made the Evolution Idea current intellectual coin, the old conception of species has more or less completely broken down; we know that specific characters are only true as *average* statements, that around the normal forms which form the majority and centre of each group of individuals there is a penumbra of variants, that variations are of constant occurrence in most living creatures, and that a species is only, as it were, an arc—defined off for convenience—on a curve of evolutionary change. A species, it may safely be concluded, represents no immutable, fixed, or unvarying group, but a very variable one, differing widely in the extent of its variation in different cases. A species is a relative and subjective conception; the reality is in the component individuals. When these are studied, it is found that they often differ from one another very markedly, though their points of agreement are also plain enough. Among the observed differences there are some which can be interpreted as the immediate and direct results of differences in function and environment; these are called 'modifications', and, so far as is possible, they must be kept apart in all questions of species-definition, since it is not known that they are in any degree transmissible. But besides these individual bodily 'modifications' there are observed differences which seem to be inborn, and are probably due to changes in the germinal matter. These germinal 'variations', as they are called, are certainly transmissible, and must be taken account of in the species-definition, although Linnæus hindered progress by his conclusion, which influenced many, 'Varietates minores non curat botanicus'. Some of these variations form well-marked minor groups which occur over and over again in different localities, and show a considerable degree of constancy. These minor groups form sub-species, or varieties, or races, or breeds; thus, there are in Europe about 200 varieties of the common whitlow-grass or *Draba verna*, and it has been computed that each wild species of plant in Europe has on an average about 10 varieties. When the variations are measured and plotted out on a curve, it is usually found that this takes the form known as the curve of frequency. The great majority of individuals are, as it were, crowded together at the summit of the curve, but on each side there is an inclined plane of variants, some of which link the species under consideration to one of its near neighbours. To change the simile, each species is like a nebula clearly marked and discontinuous if we fix our attention on the crowded centre, but vague and indefinite when the eye wanders to the straggling outlying members which seem to link one star-cluster to another. And if, after a thousand or more years, the boundaries of the nebula were found to have changed, the metaphor would be still more apposite, for we now know in regard to many species that they are in a state of gradual flux.

It remains to point out, that in defining a species there are three or four common-sense criteria which should be observed.

(a) The differences on account of which a specific name is deemed convenient should show some degree of constancy from generation to generation. The species must in some measure breed true. Thus, in an apothecary's garden at Heidelberg there suddenly arose in 1590 a variety of *Chelidonium majus*—more technically a 'mutation'—as distinct from its source as many a wild species is from its nearest ally. It is said that this form—*Chelidonium laciniatum*—has continued breeding true to this day in spite of repeated experimental attempts to shake its constancy. This was, in all probability, the origin of a new species; and the recently-reported origin of the medusoid *Pseudocytia pentata* by discontinuous variation from *Epenethia folleata* or some closely allied form may be cited as an analogous case for animals. Many other illustrations might be given. In many cases, however, this criterion of relative constancy of character has not been, or cannot be, applied, e.g. in the case of very rare or extinct organisms.

(b) The differences on account of which a specific name is deemed convenient should be greater than those which occur within the limits of the progeny of a pair. Thus, it would be nonsense to attempt to distinguish different species of man according to the differences in the colour of the hair or the eyes, for this would immediately land one in the absurdity that brothers and sisters of the same family belonged to different species. Often, however, even this common-sense criterion has been ignored.

(c) Physiologically, it should be determined whether members of a so-called species are fertile *inter se* much more readily than they are fertile with members of an adjacent species. There are many instances of hybrids between distinct species, and of fertile hybrids too; but the point is, that members of a natural species are much more readily fertile *inter se* than with members of proposed or supposed adjacent species. But it is often quite impracticable to insist on the verification of this criterion.

(d) It is of great importance to press the criterion that the distinctive specific characters must be heritable, for there is no doubt that many species have been founded simply on the occurrence of local 'modifications'.

If we take the species, e.g. *Felis tigris*, the tiger, as the unit in biological classification, it may be further noted that the next category is the *genus* *Felis*, including tigers and lions, panthers and cats; and the next the *family* *Felidae*, of 'cats' in the widest sense; and the next the *sub-order* *Æluroidea*, as distinguished from 'dog-like' and 'bear-like' animals; and the next the *order* *Carnivora*, as distinguished from Rodents and Ungulates and the like; and the next the *class* *Mammalia*, as distinguished from Birds and Reptiles and the like; and the next the *phylum* or *series* of *Vertebrata*, as distinguished from Molluscs and Arthropods and other Invertebrate phyla.

**SPECIFIC GRAVITY.** The specific gravity of a substance is its density compared to the density of a standard substance, and gives a measure of the density in terms of the standard density. For instance, the specific gravity of cast-iron is 7.21 when water is the standard substance—that is, cast-iron is 7.21 times denser than water, and a cubic inch of cast-iron is 7.21 times heavier than a cubic inch of water. A cast-iron pipe 12 feet long, 1 inch thick, and having an inside diameter of 11 inches, contains 3.1416 cubic feet; 1 cubic foot of water weighs 62.4 lbs.; multiplying the volume of the pipe in cubic feet by 62.4 x

7.21 we have 1412.8, the weight of the pipe in pounds avoirdupois. It is found more convenient to make use of specific gravities, as in the above example, than a table of the weights of cubic inches or cubic feet of different substances. Again, suppose we wish to know the volume of the inside of a glass bulb and stem; weigh the bulb and stem (suppose it to be 2 oz.), fill it with mercury and weigh again, let the weight be 34 oz.; it contains 32 oz. of mercury, the specific gravity of mercury is 13.596; the weight of a cubic inch of water is 0.576 oz. (cubic foot 62.425 lbs.); the required volume is therefore  $\frac{32}{13.596 \times 0.576}$

—that is, 4.085 cubic inches.

The number which is the specific gravity of a substance is determined by experiment, and according to circumstances different methods must be taken. To find the specific gravity of a piece of iron or similar body the body is carefully weighed in air, then it is weighed submerged in water, and its specific gravity is the weight in air divided by the difference between the weight in air and the weight in water; water is supposed to be the standard. Bodies which dissolve or chemically alter when placed in water have their specific gravities determined by indirect methods. Suppose we wish to find the specific gravity of sugar; weigh a piece of sugar in air, weigh it in linseed oil; the difference between the weight in air and the weight in oil is the weight of the size of the piece of sugar of oil, and that difference divided by .939, the specific gravity of the oil, will be the difference we should have found if it had been possible to weigh the sugar in water. If we know the weight of a bottle empty, and its weight filled with water, then the weight of the bottle filled with another substance, or part filled with a definite weight of another substance and part with water, will be a means for finding the specific gravity of the substance. Suppose the bottle to contain 1000 grains of water when full, the weight of oil or other liquid which will fill it, divided by 1000, will be the specific gravity of the liquid. Suppose 100 grains of a solid powder placed in such a bottle, and the bottle filled with water, and that then the contents weigh 1050 grains; then  $1050 - 100 = 950$  grains of water in the phial,  $1000 - 950 = 50$  grains of water displaced by 100 grains of the powder; the specific gravity of powder is therefore  $\frac{100}{50} = 2$ .

Specific gravity bottles are made to suit the different substances whose specific gravity they may be used to determine. Instruments called hydrometers are much employed to determine the densities of liquids, when this is necessary for commercial purposes. Fahrenheit's hydrometer consists of a glass stem, on which a large cylindrical bulb containing air, and a smaller bulb below it containing mercury, have been formed; it is also furnished at its top with a small pan for weights. The specific gravity of a liquid is found from the weight necessary to sink the instrument in it to a certain mark on the stem. Various instruments have been made which resemble Fahrenheit's hydrometer, but differ from it in having no scale-pan, and having the stem longer and graduated. In this case the weight (that of the instrument itself) is constant, but the volume of liquid displaced varies with the depth to which the hydrometer sinks. Such instruments are not usually graduated to give specific gravities, and they are called alcoholimeters, salimeters, lactometers, &c., according to the special kinds of liquid whose strengths they are intended to indicate. (See HYDROMETER.) Sometimes it is necessary to find the specific gravity of a very small quantity of a liquid, and in most cases this may be done by placing the drop of liquid in a quantity of other liquid which does not mix with the first;

then by adding substances which increase or diminish the density of the second liquid, till the drop will neither tend to sink nor float in it, the specific gravities are made the same, and this specific gravity may be determined. When a body is weighed in air its mass is greater than its weight by the mass of air which it displaces, but this introduces very little error in determining the specific gravities of solids and liquids, which are usually all referred to water as the unit of specific gravity. With gases it is very different. The specific gravities of gases are referred to either air or hydrogen as units, and the method of determining them is to see by means of an ordinary balance how much it takes in small, heavy weights to make a glass globe which has been exhausted exactly counterpoise an equal glass globe full of the gas to be determined. In this way the masses of equal volumes of different gases may be found; and if the numbers representing these masses be divided by the number for air or the number for hydrogen, the quotients will be specific gravities referred to air or hydrogen.

TABLE OF SPECIFIC GRAVITIES.

*Solids and Liquids Referred to Water: Temperature 4° C.*

Aluminium, .....	2.670	Iron, Wrought, .....	7.840
Antimony, .....	6.710	Lead, .....	11.360
Bismuth, .....	9.799	Phosphorus, .....	1.880
Brass, .....	8.300	Platinum, .....	21.500
Bronze, .....	8.800	Potassium, .....	0.865
Calcium, .....	1.578	Pyrites, Iron, .....	5.000
Coal, .....	1.330	Quartz, .....	2.650
Copper, .....	8.950	Silver, .....	10.580
Diamond, .....	3.500	Sodium, .....	0.972
Emery, .....	3.950	Steel, .....	7.810
Gold, .....	19.340	Sulphur, .....	2.050
Graphite, .....	2.300	Tin, .....	7.292
Ice, .....	0.920	Zinc, .....	7.146
Iron, Cast, .....	7.210		

Acid, Acetic, .....	1.063	Essential oil—	
“ Hydrochloric, .....	1.270	Bitter almonds, ...	1.049
“ Nitric (at 15° C.), .....	1.517	Cinnamon, .....	1.080
“ Sulphuric, .....	1.848	Turpentine, .....	0.864
Alcohol, Absolute (at 0° C.), .....	0.815	“ Sulphuric, .....	0.890
Ammonia (solution), .....	0.875	Mercury (at 0° C.), .....	13.596
“ (at 0° C.), .....	0.730	Milk, Cow, .....	1.030
Bisulphide of carbon, .....	1.272	Oil, Linseed (at 12° C.), .....	0.939
Bromine (at 0° C.), .....	3.187	“ Olive, .....	0.918
Cyanogen, .....	0.866	Water, Sea, .....	1.026

*Gases Referred to Hydrogen: Temperature 4° C.; Barometer 29.9 Inches.*

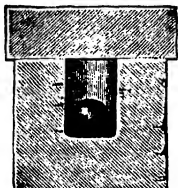
Air, .....	14.40	Hydrochloric acid, .....	18.35
Ammonia, .....	8.50	Nitric oxide, .....	15.00
Carbonic acid, .....	22.80	Nitrous oxide, .....	22.00
“ oxide, .....	14.00	Nitrogen, .....	14.00
Carburetted hydrogen—		Oxygen, .....	16.00
Heavy, .....	14.00	Sulphuretted hydrogen, .....	17.00
Light, .....	8.00	Sulphurous acid, .....	82.00
Chlorine, .....	85.50		

Taking water at 4° C. as the unit of specific gravity:—The weight of a cubic foot of any substance is equal to 62.425 lbs. avoirdupois multiplied by its specific gravity. The weight of a cubic centimeter of any substance, in grammes, is equal to its specific gravity. The weight of a gallon of any liquid, in lbs. avoirdupois, is equal to its specific gravity multiplied by 10.

SPECIFIC HEAT, the number which represents the quotient when the quantity of heat in any units, which will raise a pound or definite mass of a substance through 1° C., is divided by the quantity of heat, in the same units, which will raise a pound or like definite mass of water from 0° to 1° C. It takes very nearly equal quantities of heat to increase the temperature of a quantity of water through 1° C. between the temperatures 0° C. and 40° C. A unit of heat is sometimes taken as the quantity of heat which will raise 1 lb. avoirdupois of water 1° C. in temperature. Adopting this as the unit of heat,

the specific heat of a substance is the quantity of heat which will raise a pound of the substance  $1^{\circ}$  C.

It will be seen that the condition of a body alters with the slightest change in its temperature, and the specific heat alters with the altered condition; but when substances are taken in a decided condition of solid, liquid, or gas a range of temperatures will be found between which specific heat will be sensibly constant. Specific heats are determined experimentally, and constancy through a few degrees is usually assumed in the operation. The quantity of heat which will raise  $W$  lbs. of a substance through  $T^{\circ}$ , when  $T$  is a small number of



degrees, is expressed by  $Q = W T c$ , where  $c$  is the specific heat. The accompanying cut represents a ball of metal or other material, whose specific heat we wish to determine, placed in a cavity which has been made in a block of ice having a temperature of  $0^{\circ}$  C. Suppose the ball in the figure to be lead (1 lb. mass), and that it has been heated to  $10^{\circ}$  C. previous to placing it in the cavity of the ice block; when the lead has cooled to  $0^{\circ}$  C. the water melted is carefully taken up on blotting-paper which has been previously weighed, and by weighing the paper a second time, and subtracting the first weight from the second, we find the quantity of water; this quantity multiplied by 79 ( $79^{\circ}$  C. is the difference between the latent heat of ice at  $0^{\circ}$  C. and water at  $0^{\circ}$  C.), and divided by the product of the numbers representing weight of lead and the temperature from which the lead has cooled, will give the specific heat of lead— $\frac{.004 \times 79}{1 \times 10} = .0316$ .

Various modifications of the ice calorimeter are employed. A method of finding specific heats called *the method of mixtures* may be described by an example. The quantity of heat in 2 lbs. of water at  $6^{\circ}$  C. is  $2 \times 6$ , the quantity of heat in 20 lbs. of mercury at  $15^{\circ}$  C. is  $20 \times 15 \times c$ , where  $c$  is the specific heat of mercury; if 20 lbs. of mercury at  $15^{\circ}$  C. are mixed with 2 lbs. of water at  $6^{\circ}$  C., the mixture will have a temperature of about  $8.22^{\circ}$  C.; now  $2 \times 6 + 20 \times 15 \times c = 2 \times 8.22 + 20 \times 8.22 \times c$ , whence  $c = .033$ . It will be seen that ounces of water and mercury may be taken in place of pounds, and the result will be the same. In practically determining the specific heat by the method of mixtures the question is somewhat more complicated, because the effects of the containing vessel, the thermometer, the glass rod for stirring, and the effect of loss by radiation and conduction during the experiment must be taken into account. Very elaborate apparatus have been constructed to reduce the loss by radiation and conduction as much as possible, for descriptions of which special treatises must be consulted. The other sources of error may be allowed for by calculation and previous knowledge of the specific heats of the materials of which the containing vessel, the stirrer, and thermometer are made. Thus let  $W$  be the weight of the substance whose specific heat is to be determined;  $w_1, w_2, w_3$ , and  $w_4$  the weights of water, containing vessel, thermometer, and stirrer respectively;  $c_1, c_2, c_3$ , the corresponding known specific heats; and  $x$  the specific heat to be determined; let  $T$  be the temperature of the substance, and  $t$  that of the water, &c.; we have—

$$W T x + (w_1 + w_2 c_2 + w_3 c_3 + w_4 c_4) t = W t x + (w_1 + w_2 c_2 + w_3 c_3 + w_4 c_4) T$$

whence

$$x = \frac{(w_1 + w_2 c_2 + w_3 c_3 + w_4 c_4)(T - t)}{W(T - t)}$$

If the substance be inclosed in an envelope of weight  $m$ , and specific heat  $a$ , the above value for  $x$  will become

$$x = \frac{(w_1 + w_2 c_2 + w_3 c_3 + w_4 c_4)(T - t) - m a(T - t)}{W(T - t)}$$

Dulong and Petit's law:—*The product of the specific heat of any body and the atomic weight of the body is a constant quantity.* On account of specific heat being influenced by the condition in which the body is, the above law does not hold accurately with many experimentally-found specific heats; but it appears to be truly the law when (as with the specific heats of gases) specific heats are taken of substances as nearly as possible in the same condition. Dulong and Petit's law expresses that an atom of mercury takes the same amount of heat to raise it  $m^{\circ}$  as is taken to raise an atom of hydrogen or any other substance  $m^{\circ}$ . In connection with gases two kinds of specific heat are distinguished, namely, specific heat at constant pressure and specific heat at constant volume. Regnault has experimentally established (1) whatever be the temperature and pressure of a gas at which its specific heat, per unit of mass, has been determined this number is the same; (2) when we know the specific heat of a gas whose atomic weight we know, we may find the specific heat of any gas whose atomic weight we know; for the specific heats are inversely as the atomic weight. The ratio of specific heat at constant pressure to specific heat at constant volume is a constant amount (1.41).

*Specific Heats. Water = 1.00000.*

Antimony,.....	0.05077	Phosphorus,.....	0.18870
Silver,.....	0.05601	Platinum,.....	0.03243
Arsenic,.....	0.08140	Lead,.....	0.03140
Bismuth,.....	0.03084	Plumbago,.....	0.21800
Cadmium,.....	0.05689	Sulphur,.....	0.20259
Charcoal,.....	0.24150	Glass,.....	0.19738
Copper,.....	0.09215	Zinc,.....	0.09555
Diamond,.....	0.14680	Ice,.....	0.50400
Tin,.....	0.05828	Mercury,.....	0.03882
Iron,.....	0.11979	Acetic acid,.....	0.6589
Iodine,.....	0.05412	Alcohol at 36°,.....	0.6735
Brass,.....	0.09391	Benzine,.....	0.5952
Nickel,.....	0.10860	Ether,.....	0.5187
Gold,.....	0.03244	Oil of turpentine,.....	0.4629
Air at constant pressure,.....			0.2875

SPECTACLES are of two chief sorts, according as they are intended for short-sighted or far-sighted persons. In the former case they must be concave; in the latter, convex. (See SIGHT, DEFECTS OF.) In both cases care should be taken to adapt the degree of concavity or convexity to the condition of the eye; for since the eye gradually accustoms itself to glasses continually used, the defect in the vision will be increased by the use of such as are too powerful, while it may be diminished, or at least prevented from increasing, by those of an opposite character. In addition to this it ought to be considered that, with most persons, the field of vision in one eye is greater than that in the other. But if a person, in the selection of spectacles, suffers himself to be guided merely by the first impression he will commonly choose glasses that are too powerful, and seldom be able to adapt them to both eyes. Opticians have a contrivance for determining the degree of short or far sightedness, and the glasses are numbered according to their degree of convexity or concavity, so that suitable ones may be more readily selected. Those persons who are far-sighted should refrain, as long as they conveniently can, from increasing the power of the glasses. To afford the means of seeing distinctly, and to be used without injury, spectacles should be regularly formed; that is to say, the concavity or convexity should be uniform. Moreover, the glasses should be perfectly transparent, and entirely destitute of colour. Green

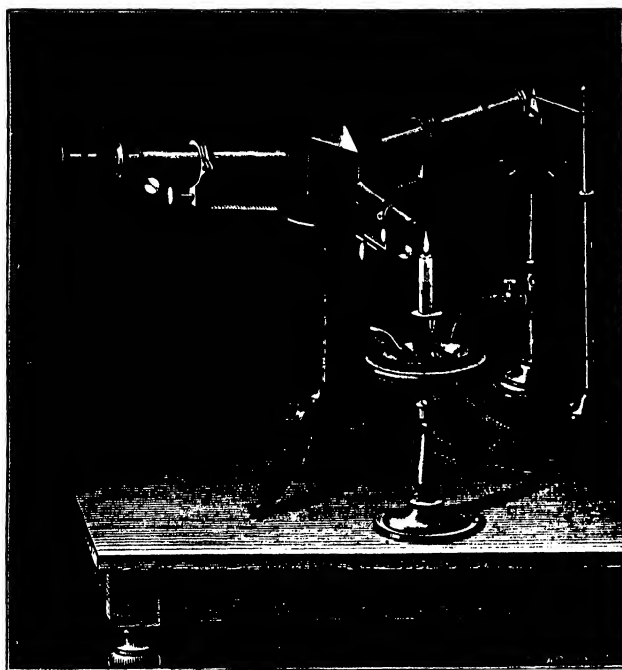
spectacles are to be recommended only to such persons as have very sensitive eyes, or to such as are exposed for a long time to a glittering white surface (for instance, snow in bright sunshine). Spectacles are also used to cure squinting. These have no glasses, but consist merely of a thin plate of some substance. In the middle, opposite the axis of the eye, there is a small opening, to which the pupil must turn in order to see anything. In this way it gradually becomes accustomed to the proper direction. The ancient Greeks and Romans were entirely unacquainted with the use of spectacles. At the close of the thirteenth century Roger Bacon speaks of them, and to him their invention is by some ascribed. Others ascribe the invention to a Florentine monk, Alessandro di Spina; and the tombstone of another Florentine, named Salvino, bears that he was the inventor. Both of these were contemporaries of Roger Bacon. Wolverhampton is the chief seat of the manufacture of spectacles in this country, and so delicate is the workmanship that a pair of spectacles is sometimes less than  $\frac{1}{4}$  oz. in weight.

**SPECTROSCOPE**, an instrument by means of which a spectrum may be conveniently observed, or various spectra compared with one another. Many forms of spectroscopes are constructed, suited to the

of the prism. The tube pointing to the candle has at this end a scale engraved or photographed on glass, and the image of the scale is transmitted through the collimator of this tube to the prism, from the side of which it is reflected, and it appears in the telescope side by side with the spectrum.

**SPECTRUM**, an effect produced by a beam of light which has been refracted by a prism. Sir Isaac Newton first artificially produced a spectrum. In his experiment a round hole in the shutter of a darkened room let in a beam of sunlight; this was received by a prism of glass, and after emerging from the prism the round beam was found to have altered in section, and gave as its cross section, on a screen, a long band or ribbon with semicircular ends. The beam had also altered in colour, for the image, instead of being white, exhibited the colours of the rainbow in order; this image or band of colours was the solar spectrum. In Newton's experiment the strong beam of direct sunlight gave a well-coloured effect capable of showing itself brilliantly on a screen; but if the hole in the shutter be looked at from any part of the room through the prism the image of the hole will be to the eye such a spectrum as that thrown on the screen. In most cases the spectra to be observed are those of lights too feeble

to give images on screens, and they are observed through instruments directly (see **SPECTROSCOPE**); it will be well, however, in reading both this article and the article on **SPECTRUM ANALYSIS** to carry the idea of the hole in the shutter, the prism in the path of the beam, and the screen for receiving the image. Suppose we use an artificial source of light, such as the flame of a spirit lamp or of a Bunsen burner, coloured with different substances; let the hole be the shape of the letter S, and let it have a collimating lens placed inside to bring the diverging rays of light from the source into a parallel beam. First, let the source of light be a flame coloured with common salt, the spectrum will be simply a yellow letter S; second, let the source be a flame coloured with common nitre, the spectrum will be three letters S, two red letters overlapping, and one violet letter at some distance from the first two. The reason we had only one image of the *slit* (as we may now call the opening in the shutter) when we used the salted flame is that the light emitted by heated sodium is nearly all of one colour; for rays of light of one colour, on passing through a prism, being bent



different kinds of spectral research. The simplest mode of producing a spectrum is described in the article **SPECTRUM**. In the figure the two tubes to the right contain two convex lenses called collimators; that to the left is a telescope. The light farthest to the right is that to be examined. The tube pointing to it is closed at that end by a cap having a vertical slit, which may either be widened or narrowed by an arrangement which may be observed as indicated on the figure. The collimator of this tube makes the rays which come through the slit parallel, the parallel beam reaches the prism, and after refraction is received in the telescope, through which it is viewed as a spectrum, having been spread out by the action

to the same amount, give one image. Similarly, in the case of the nitre the light is that given out by heated potassium, which light is of three definite colours, giving three distinct images. The slit employed for most purposes is merely a fine straight line or slit having a direction parallel to the edge of the prism. Using a straight fine slit it is evident that with a sodium flame we should have a line of yellow light, the image of the slit, for spectrum; and with the potassium we should have three lines, just as we had three letters S in the arrangement described. The electric light gives a continuous spectrum—that is, its spectrum is a continuous band like what Newton's solar spectrum appeared to him, and is formed of a

series of images of the slit placed side by side (or rather considerably overlapping), and if one or more of these images can be cut off there must appear corresponding vacant spaces or dark lines on the spectrum. If the flame containing common salt or sodium be placed in the path of the light received by the slit from an electric lamp it will be seen that yellow rays will be intercepted, and in the exact place where the sodium itself gave a bright line we find a dark line. This is called the reversal of the sodium line. In the same way the lines of potassium may be reversed. On producing a spectrum by means of a prism one position of the prism will be found by rotating it in which the spectrum is least extended; this is the position that is always observed in spectrum experiments. See SPECTRUM ANALYSIS.

SPECTRUM ANALYSIS, the discrimination of bodies by means of their spectra, and by the instrument known as the spectroscope. In the above article it has been mentioned that Newton was able to examine the spectrum of sunlight and to display it on a screen. He did not detect one important feature of the solar spectrum, however, namely, that it is crossed by a numerous series of dark lines, constituting, if we may so say, dark images of the slit mentioned above. Each of these is an indication that a particular kind of elementary ray is wanting in solar light. Every elementary ray that is present gives its own image of the slit in its own peculiar colour; and these images are arranged in strict contiguity, so as to form a continuous band of light passing by perfectly gradual transitions through the whole range of simple colour, except at the narrow intervals occupied by the dark lines. The first coloured band given on the accompanying plate is a rough representation of the appearance then produced. If the slit is illuminated by a gas flame, or by any ordinary lamp, instead of by solar light, no such lines are seen, but a perfectly continuous spectrum is obtained. The dark lines are therefore not characteristic of light in general, but only of solar light. Early in the present century Wollaston saw and described some of the more conspicuous of them; and some time later Fraunhofer counted about 600 of them, and put down a large number in their proper places in a map of the spectrum constructed by him. Some of the principal lines he distinguished by letters of the alphabet, beginning with A in the red and going on to H in the violet. (See the Plate.) These lines, which are often spoken of as Fraunhofer's lines, are constantly referred to as reference marks for the accurate specification of different portions of the spectrum. They always occur in precisely the same places as regards colour, but do not retain exactly the same relative distances one from another when prisms of different materials are employed, different parts of the spectrum being unequally expanded by different refracting substances. The inequality, however, is not so great as to introduce any difficulty in the identification of the lines. The same system of dark lines is found in the spectra of the moon and planets, this being merely a consequence of the fact that they shine by the reflected light of the sun. The spectra of the fixed stars also contain systems of dark lines which are different for different stars (as shown in the Plate). Flames emitting the light of incandescent gases give a discontinuous spectrum consisting of a finite number of bright lines. The spectra of incandescent solids and liquids are completely continuous, containing light of all refrangibilities from the extreme red to a higher limit depending on the temperature. The characteristic features exhibited by different spectra will be understood from the Plate, which shows the spectra pertaining to certain fixed stars, gases, and several of the more easily

volatilized metals, the solar spectrum being given at the top for comparison. The bright lines of some of these substances are precisely coincident with some of the dark lines in the solar spectrum. The more remarkable of them are marked by the Greek letters  $\alpha$ ,  $\beta$ ,  $\gamma$ , &c. The scale at the top, which is graduated from 1 to 170, corresponds to the scale that forms part of the spectroscope. See SPECTROSCOPE.

The fact that certain substances when incandescent give definite bright lines has been known for many years, from the researches of Brewster, Herschel, Talbot, and others, but it was for a long time thought that the same line might be produced by different substances, more especially as the bright yellow line characteristic of sodium was often seen in flames in which that metal was not supposed to be present. Professor Swan, having ascertained that the presence of the 2,500,000th part of a grain of sodium in a flame was sufficient to produce it, considered himself justified in asserting, in 1856, that this line was always to be taken as an indication of the presence of sodium in larger or smaller quantity. But the greatest advance in spectrum analysis was made by Bunsen and Kirchhoff, who, by means of a four-prism spectroscope, obtained accurate observations of the positions of the bright lines in the spectra of a great number of substances, as well as of the dark lines in the solar spectrum, and called attention to the identity of several of the latter with several of the former. Since the publication of their researches the spectroscope has come into general use among chemists, and has already led to the discovery of four new metals, cesium, rubidium, thallium and indium. For some highly important facts revealed by the spectroscope in regard to the physical condition of the sun, see the article SUN.

Another important point has been brought out by spectrum analysis. Arguing from the undulatory theory of light that a luminous body, such as a star, if approaching us would give rise to a greater number of undulations, if receding would give rise to a smaller number than if it stood still, it has been shown by spectroscopic observations that the star Sirius must be receding at the rate of about 20 miles per second, this being determined by the displacement of the F line of its spectrum as compared with that of the sun or of hydrogen. The star Arcturus, on the other hand, is approaching at the rate of about 50 miles per second. Spectrum analysis is also employed in the detection of blood. If the light from a source giving a continuous spectrum passes through a glass vessel containing water with a little blood dissolved in it, the dark absorption bands indicating blood appear on the spectrum, and with a special instrument called a micro-spectroscope the most minute trace of blood may be detected.

SPECULAR IRON. See IRON (ORES OF).

SPECULUM, a polished metallic surface used to reflect images. Specula are employed in large telescopes as reflectors. The metal of which Lord Rosse's specula are made is an alloy of four parts copper to one part tin. It is found most convenient to make the largest telescopes reflecting telescopes. The great thickness of an object-glass when of large size produces considerable absorption of light, and this, and the difficulty in manufacturing large glass lenses, have hitherto deterred makers from attempting an achromatic object-glass of much more than 2 feet diameter. There appears to be no objection, except weight, to our having a speculum as large as we like. When a speculum has been cast, it must be cut and polished to a perfect parabolic surface, a process of great nicety; besides, it must be sufficiently heavy to prevent distortion or flexure from any cause while in use. The metal soon loses its polish, and there is





great trouble in keeping it bright without injuring the shape. It is found that an improved speculum in these respects is made of glass which has been ground and polished to shape once for all, and then covered with silver by the process known as Liebig's. Such are called silvered specula.

**SPECULUM METAL**, an alloy of tin and copper with a small quantity of arsenic.

**SPEECH**, the production of articulate sounds by the larynx or organ of voice and other structures. Through speech man holds communication with his fellows, and is thus raised to an almost immeasurable height above lower forms of animal life; the varied powers of *expression* constituting perhaps the most remarkable of the gifts or attributes which the possession of speech bestows. The *voice* itself consists of certain tones, which, produced in a certain sequence, constitute *music*; but *speech* proper consists in the tones of voice becoming *modified*, through the agency of the tongue, cheeks, lips, and other structures which intervene between the glottis and the outer opening of the mouth. Speech therefore consists in certain modifications of voice, and without these modifications the essential idea of speech is lost. Music, as consisting of voice alone, may undoubtedly express the feelings of man—but this expression is obviously of the most limited kind, when compared with the powers with which speech invests its possessors. The production of voice itself, and of musical tones, will be considered in the article **VOICE** (which see); and the structure of the larynx has already been fully described and illustrated in the article of that name. Speech, as above defined, of some kind or other constitutes the *language* of every nation, and the modifications of articulate sounds which may be invented and used by man is almost unlimited. As a rule the more common sounds in languages are those which are most easily produced by the larynx. No one language contains all the sounds capable of being produced; and indeed the differences between languages appear in the main to consist in the diversity of the leading or more common combinations of sounds of one language, as distinguished from those of another. In speech two classes of sounds are produced, these being usually known as *vowels* and *consonants*. Vowels are pronounced by sounds coming primarily from the larynx; consonants being formed by sounds caused by the interruption of the currents of air in the mouth or passages above the larynx. The name *consonant* has, in fact, been applied to the sounds of that name from their being for the most part sounded effectively only when allied with a vowel. Thus the consonants *b* or *g* and *p* or *k*, when sounded, imply combination with a vowel-sound. The vowels are further distinguished by the fact that they can be sounded mutely, that is, without an appreciable voice sound, or in a whisper. The mouth-cavity would appear, however, to assume the same form in the production of mute, as in the production of vocalized or sounded vowels. Kempelen's researches have shown that the conditions required to change the same sound into different vowels consist simply in variations in the size of the mouth-cavity and of its opening; and the following table has been constructed by him to express the relative dimensions of the two cavities. He recognizes five degrees of size in the mouth-cavity itself (or space between the tongue and palate) and in the oral aperture as well.

Vowel.	Sound.	Size of mouth-opening.	Size of mouth-cavity.
a	as in <i>far</i> ,	5	8
æ	as in <i>name</i> ,	4	3
e	as in <i>theme</i> ,	3	1
ε	as in <i>cold</i> or <i>go</i> ,	2	4
œ (continental u)	as in <i>cool</i> ,	1	5

It may also be noted that considerable differences exist between the *duration* of different articulate sounds. As exemplified in the production of such consonants as *b*, *p*, and *d*, the utterance cannot be prolonged to any great extent at the will of the speaker. Such are termed *explosive* consonants. On the other hand, such consonants as *h*, *m*, *n*, *l*, *r*, *s* are named *continuous*, from the fact that their sounds may be prolonged to an indefinite extent, so long, indeed, as the particular shape of the mouth and expiration are carried on. The explosive sounds are incapable of union with intonation or vocal tone, and are in this respect absolutely mute; whilst continuous consonants are of a more or less musical and intoned kind. The study of the respective acts and processes involved in the production of speech and of its various constituent sounds, is of the greatest importance in view of the successful treatment of many affections of speech, of which *stammering* is the most common and the most grievous. This distressing complaint appears usually to result from a want of power to combine and unite the different muscular actions concerned in the production of speech, with the effect of producing disjointed expressions of the constituent parts of words or sounds. Dr. Marshall Hall regarded the causes of stammering as due essentially to abnormal states of the nervous centres. This cause was termed *centric* when it was believed to arise from the nerve-centre itself being affected, and *eccentric* when it proceeded from abnormal impressions in its afferent nerves. The first condition probably includes the vast majority of the causes of stammering. Those continuous consonants in the pronunciation of which no air passes through the nose, and where the parts of the mouth in their pronunciation are firmly compressed, are the sounds in the expression of which the stammerer finds most difficulty. Such are the consonants *v* and *f*. The cure of this complaint appears most naturally to lie in the direction of inculcating confidence in the patient's own powers of overcoming the difficulty, by time, patience, perseverance, and above all by careful attention to the clear, steady articulation of the different letters. Dr. Arnott's method of cure consisted in making the patient connect his words by a vocal intonation, so as to avoid stopping the breath. When stammerers are able to sing distinctly enough, this power is probably due to the fact that in singing the glottis is kept open, and less liability to spasmodic action exists. In *ventriloquism* laryngeal sounds are modified probably through peculiarities in the acts of breathing. This habit may be acquired by practice; and it is well known that the success of the ventriloquist does not altogether depend on his deceiving the hearing sense alone; since, the attention being directed to any given point from which sounds arise, our imagination leads us to look to that point as the source of the sounds, and unconsciously aids in the deception. In the deaf and dumb no 'finding conception or recalled sensation' of the nature of vocal sounds or musical tones exists; and hence, although the organs of voice are perfectly developed, no power of uttering vocal sounds is present. The absence of hearing powers, in the first instance, prevents the conception of sounds and also prevents their imitation. Persons born deaf are thus necessarily dumb. But through training such persons may speak in a more or less satisfactory manner. Where dumbness exists alone the affection probably depends on some deep-seated affection of the nervous centres, exhibited in many cases of nervous disease. In Dr. Kitto's *Lost Senses* will be found an interesting account of his own case, in which he lost the power of voice through an affection of the hearing—the latter being the result of an accident. See also **VOICE**.

**SPEISS.** In the preparation of smalt a product is obtained consisting of mixed arsenides and sulphides of nickel, copper, and iron. To this substance, which has a brilliant metallic-like appearance, the name *speiss* is given. See **SMAILZ**.

**SPELTZER.** See **SOLDER**.

**SPENCE, WILLIAM**, an eminent naturalist, was a native of Yorkshire, and in early life engaged in business in Hull. The study of natural history and the observation of the habits of animals, more especially insects, early formed a favourite pursuit with him, and having accidentally made a journey into Suffolk, he made there the acquaintance of the distinguished entomologist Mr. Kirby (see **KIRBY**), the result of which was the joint production by the two of the well-known Popular Introduction to Entomology. The first volume of this work appeared in 1815, and it was subsequently completed in four volumes. A seventh and cheap edition of the first two volumes (the popular portion of the work) was published in 1856. He was a fellow of the Royal, Linnean, and Entomological Societies, and of the last he was at one time president. During the latter part of his life he resided in London, where his death took place on the 6th of January, 1860.

**SPENCER, GEORGE JOHN, EARL**, was of the second branch of the Spencer family, the elder possessing the title of Duke of Marlborough. His father, in 1761, was created Baron Spencer, and in 1764 Viscount Althorp and Earl Spencer. George John was born at Wimbledon in 1758, and was educated at Harrow, and afterwards had for his tutor the celebrated Sir William Jones. From Harrow he removed to Trinity College, Cambridge. When he had completed his education he travelled, and on his return was elected member of Parliament for the county of Northampton. In 1789, by his father's death, he became Earl Spencer. In the House of Lords he voted with the Whigs, till the period of the French revolution, when, with some others of the party, he joined the party of Pitt, after which he was for some time a member of the Pitt administration. In 1801 he retired with Pitt, but afterwards again joined his old friends, and when they came into place in 1805 he was appointed secretary of state for the home department. He died at his seat of Althorp, in Northamptonshire, on the 10th November, 1834. Earl Spencer was president of the Roxburghe Club at its origination, and possessed the largest and richest private library in the world. The foundation of his library was laid in 1789, by the purchase of Count Rawiczki's collection, for an annuity of £500 sterling. This collection he increased, at a great expense, by the purchase of books in all parts of Europe. A catalogue of the rarest and most costly works of the collection has been prepared by Dibdin—*Bibliotheca Spenceriana*, or a Descriptive Catalogue of the Books printed in the Fifteenth Century, and of many Valuable First Editions (four vols., 1814–15). It contains engravings, woodcuts, and facsimiles. The bulk of this library is now included in the Rylands Library, Manchester.

**SPENER, PHILIPP JAKOB**, a celebrated divine of the Lutheran Church in the seventeenth century, was born in 1635, at Rappoltswiller, in Upper Alsace. His piety was early awakened by his patroness, the Countess of Rappolstein, and was confirmed by witnessing, at the age of fourteen years, her preparation for death. In 1651 he commenced his theological studies at Strasburg, became in 1654 tutor of the Princess of the Palatinate, and delivered lectures on philosophy and history. From 1659 to 1662 he travelled in Germany, Switzerland, and France, and in the last-mentioned country became acquainted with the Jesuit Menestrier, celebrated

for his knowledge of heraldry, and having been thus led to study this science wrote several works on heraldry, still much esteemed. In 1664 he was made Doctor of Theology at Strasburg, and in 1666 he received the office of senior clergyman at Frankfurt-on-the-Main. In 1670 he instituted his celebrated *collegia pietatis*, which, against his will, became the origin of *pietism*. From this time Spener's history is wholly connected with this remarkable change in the religious state of Protestant Germany, as it was chiefly owing to his example and the spirit of his writings. The Lutheran Church at that time was fast sinking into a lifeless dogmatism. Doctrines, forms, and polemics were confounded with a religious life. Spener, in his *Pia Desideria* and other treatises, exposed the evils of this state of things, and showed how the important office of the ministry had become alienated from its proper purpose—that of instructing the people in true religion, correcting their faults, and alleviating their afflictions. From 1686 to 1691 he was preacher to the court in Dresden, and even then occupied himself with the religious teaching of children. A representation which he made to the elector in writing respecting his faults brought him into disgrace. He went in 1691 to Berlin, where he took an active part in the foundation of the University of Halle. In 1698 the court of Dresden invited him to return; but he preferred to remain in Berlin, where he was in the possession of high appointments. He died in that city in 1705. See **PIETISM**.

**SPENSER, EDMUND**, a celebrated English poet, was born in London, near the Tower, about 1552. He was descended from the Spensers of Hurstwood, Lancashire, and remotely connected with the family of Sir John Spenser of Althorp. He received his earlier education at the Merchant Taylors' School, and was admitted as a sizar of Pembroke Hall, Cambridge, on the 20th of May, 1569. He graduated as B.A. on the 16th of January, 1573, and as M.A. on the 26th of June, 1576. On leaving the university he took up his residence with some of his relations in the north of England, where he unsuccessfully wooed a lady whom he celebrates under the name of Rosalind in his *Shepherd's Calendar*. The *Shepherd's Calendar* was first published in 1579, but it did not bear his name. Ten years before, a few sonnets translated from Petrarch, which were long afterwards republished in Spenser's *Complaints*, had appeared in Van der Noodt's *Theatre of Worldlings*. The year before the publication of the *Shepherd's Calendar* he had been advised by his friend Gabriel Harvey to remove to London, where he entered the household of the Earl of Leicester. Through his patron he became acquainted with Sir Philip Sidney, to whom he dedicated his poem. In 1580 he was appointed, through the influence of Sidney, secretary to Lord Grey de Wilton, lord-lieutenant of Ireland, and accompanied him to his seat of government. In 1581 he got the appointment of clerk of degrees and recognizances in the Irish Court of Chancery. In 1586 Lord Grey, in conjunction with the Earl of Leicester and Sir Philip Sidney, procured for him a grant of upwards of 3000 acres in the county of Cork, out of the forfeited lands of the Earl of Desmond; on which, however, by the terms of the gift, he was obliged to become resident. He accordingly fixed his residence at Kilcolman, in the county of Cork, probably not later than 1588, in which year he resigned his clerkship in the Court of Chancery. In 1588 he was appointed clerk of the council of Munster, and in the following year he received a visit from Sir Walter Raleigh, who, since the death of Sidney in 1586, had become his most intimate friend, and whom he

celebrates under the title of the Shepherd of the Ocean. He was then engaged in the composition of the *Faerie Queene*, of which he had written the first three books. With these he accompanied Raleigh the next year to England, where they were published in 1590, with a dedication to Queen Elizabeth, and an introductory letter to Raleigh, explaining the nature of the poem. Raleigh also gained him the favour of the queen, who rewarded his poetry and dedication with a pension of £50. It is not improbable that on occasion of this visit he made the acquaintance of Shakspeare. (See SHAKSPEARE.) In 1591 his rising reputation induced his bookseller to collect and print his smaller pieces, which were published under the title of *Complaints*. It was probably in the same year that the *Daphnaida* was first published, and it is certain that before the close of that year Spenser was again at Kilcolman. He then passed an interval of two or three years in Ireland, where, in 1594, he married, being then in his forty-first year. The courtship of the lady he married is celebrated by him in his eighty-eight sonnets, and the consummation to which the courtship led, in his *Epithalamium*. In 1595 he paid another visit to London, and again made this the opportunity of publishing some of his works. These were, first, a volume containing Colin Clout's *Come Home Again*, and *Astrophel and The Mourning Muse of Thestylis*, the last two being elegies on the death of Sir Philip Sidney; second, his sonnets and *Epithalamium* in one volume; third, the fourth, fifth, and six books of the *Faerie Queene*, together with a new edition of the first three books; fourth, his *Prothalamium* or Spousal verse on the marriages of the Ladies Elizabeth and Catharine Somerset; and fifth, *Four Hymns in Honour of Love, of Beauty, of Heavenly Love, and of Heavenly Beauty*, together with a reprint of his *Daphnaida* and *Epithalamium*. The first two of these publications appeared in 1595, the others in 1596. It was probably also during this visit that he drew up his *View of the State of Ireland*, which was presented to Queen Elizabeth, but which lay in MS. until printed, in 1633, by Sir James Ware, who bestows much applause on the information and judgment displayed in it. It appeared in the year mentioned as part of a work bearing the title of a *Chronicle of Ireland*, by Meredith Hanmer, Edm. Campion, and Edm. Spenser. In 1597, probably early in the year, Spenser returned to Ireland, and in September, 1598, he was appointed sheriff of the county of Cork. The rebellion of Tyrone, however, took place in October, and proceeded in the district in which Spenser lived with such fury as to compel him and his family to quit Kilcolman in so much confusion that an infant child was left behind, and burned with his house. The unfortunate poet arrived in England with a heart broken by these misfortunes, and died the 16th of the following January, 1599, in the forty-sixth year of his age. It is asserted that he terminated his life in great distress; but it has been contended that the poverty referred to by Camden and several of his poetical contemporaries applies rather to his loss of property generally than to absolute personal privation. This inference seems the more probable, as he was interred in Westminster Abbey at the expense of the Earl of Essex, who would scarcely have allowed the man to starve whom he thus honoured. A monument was afterwards erected over his remains by the celebrated Anne, countess of Dorset. Of the personal character of Spenser there is no direct testimony; but it may be inferred from the friendships which he formed, and from the purity, devotion, and exalted morality of his writings. As a poet, although his minor works contain many beauties, Spenser will be

judged chiefly from the *Faerie Queene*, the predominant excellencies of which are imagery, feeling, and melody of versification. With all its defects it furnishes admirable examples of the noblest graces of poetry, sublimity, pathos, unrivalled fertility of conception, and exquisite vividness of description. The Orlando Furioso of Ariosto was his professed model in writing it. Its great length and want of interest as a fable, added to the difficulties of the language (which was in great part obsolete even in his own day), may, indeed, deter readers in general from a complete perusal, but it will always be resorted to by the genuine lovers of poetry as a rich store-house of invention. In the full title the poem is described as 'disposed in twelve books fashioning twelve moral virtues,' and the introductory letter to Raleigh shows that the work was intended to be throughout allegorical. The virtues 'fashioned' in the six complete books are Holiness represented by the Redcrosse Knight, Temperance by Sir Guyon, Chastity by Britomart, 'a Lady Knight,' Friendship by Cambel and Triamond, Justice by Artegall, and Courtesy by Sir Calidore. The stanza which Spenser has adopted in the *Faerie Queen* is usually called the Spenserian, and is no doubt of his own invention. It consists of a strophe of eight decasyllabic verses and an Alexandrine, and has a threefold rhyme—the first and third verses forming one, the second, fourth, fifth, and seventh another, and the sixth, eighth, and ninth the third. When well managed it is majestic in its character, but with inferior versifiers is apt to become languid and heavy. It has been largely adopted by later poets, as by Beattie in his *Minstrel*, Byron in his *Childe Harold*, &c. Of the *Faerie Queene* there appeared, besides the six books above mentioned, two cantos on Mutability, which were first published in the folio edition of the *Faerie Queene* in 1611, and which were introduced in that edition as apparently part of a book of that poem under the legend of Constaney. The rest of the last six books of the *Faerie Queene* was probably never completed, but it is probable that some parts of them were composed but lost in the fire by which his house was destroyed in 1598. The best annotated editions of Spenser's complete works are those of J. Payne Collier (five vols., 1862) and Dr. Grosart (ten vols., 1880-82), and the best one-volume edition, that edited by R. Morris (1869; new ed. 1897). Some of the separate books have been published with notes in the Clarendon Press series. See Craik's *Spenser* and his *Poetry*.

SPERM-OIL. See SPERM-WHALE.

SPERMOPHILE. See MARMOT.

SPERM WHALE, or CACHALOT (*Physeter*), the name specially given to a species of Cetacea belonging to the family of the Catodontidæ or Physeteridæ, a group belonging to that section of the Whale order denominated 'toothed' whales, in contradistinction to those which possess *baleen* or whalebone-plates (Balenidæ). The Physeteridæ as a family are distinguished by the absence of baleen, and by the presence of numerous (about fifty-four) conical, pointed teeth in the lower jaw, whilst those of the upper jaw are rudimentary, and rarely or never cut the gum. The head is exceedingly large and massive, and forms about a third of the total length of the body; whilst the 'blow-holes' or nostrils are united to form an opening of crescentic shape, and are situated (in the typical Sperm Whale) in front of the head. The Sperm, or Spermaceti Whale as it is sometimes called, attains a very large size, and may measure from 50 to 70 or 80 feet in length. Its scientific designation is *Physeter* or *Catodon macrocephalus*, the latter name meaning 'long-headed.' The back appears 'humped,' and rises abruptly in front, but tapers

towards the tail extremity. The colour is a blackish-gray, which may exhibit greenish or bluish hues on the upper parts. The teeth of the lower jaw average each about 3 inches in length. They are set in a common (*alveolar*) groove, which is only partially divided by septa or partitions into 'tooth-sockets'. The snout is very broad, and abruptly truncated. The Sperm Whale is noted in a commercial or economic aspect, not only for the oil obtained from the blubber, but for various other valuable products. The blubber attains a depth of about 12 or 14 inches in this species, and is consequently not of great thickness when compared with that of other species of whales. The spermaceti, which forms a very characteristic product of these animals, is contained within the head in two large special cavities, and is also diffused through the blubber itself. It is an oily substance of clear appearance and white colour, but which concretes and solidifies when exposed to the air. A large quantity of oil is usually mixed with the spermaceti itself, and this oil has to be removed in commerce to purify the latter substance. To obtain it in its purest condition it has to be boiled in alcohol, from which it is deposited in the form of laminated white crystals. Twenty-four barrels of spermaceti have been obtained from a specimen 64 feet long, the same whale yielding 100 barrels of oil. The substance known as ambergris is also obtained from these whales. It is found within the stomach and intestines, and is very generally believed to represent an abnormal or biliary concretion (or gall-stone), its analysis showing it to be composed of a substance nearly allied to cholesterine, which forms the chief compound of gall-stones. A mass of 50 lbs. weight has been found within the body of a single whale. Spermaceti is used as an element in ointments and other medicinal compounds, and for making candles; whilst ambergris is chiefly used in the manufacture of various perfumes. The sperm-oil, which is free from the peculiar smell of other 'whale oils', is used for burning in lamps. The United States sperm fisheries afford the chief supply of this oil.

The Sperm Whale inhabits the southern oceans, and very rarely ventures into more northern seas. Its food appears to consist chiefly of cuttle-fishes and smaller molluscs; and it is gregarious in habits, the 'herds' or 'schools' each containing several hundreds of these animals. The schools generally exhibit a division into a band of young males and one of females, several old males, or 'schoolmasters', being attached to the latter band. Sometimes, when irritated or roused to anger, these whales will attack and destroy the whale-boats. They are much attached to their young, and generally produce but one young one at a birth. No particular season seems to be regarded as the breeding season *par excellence*. Sperm whales have occasionally been found stranded on British shores. See the plate at CETACEA, fig. 10.

SPESSART, a range of hills in Germany, which commences in the north-west of Bavaria, on the right bank of the Main, and stretches N.E. partly through the Prussian government of Cassel. Its highest peak is 2020 feet in height.

SPEY, a river in Scotland, rises about midway between Loch Laggan and Loch Oich in Inverness-shire, flows north-east through the beautiful valley of Strathspey, forming in part of its course part of the boundary between the counties of Elgin and Banff, and falls into the Moray Firth a little below Garmouth, after a course of about 107 miles. Its current at first is somewhat sluggish, but afterwards becomes very rapid, so that it is useless for navigation. It is chiefly used for floating down timber, and is noted for its salmon fisheries. Its only important tributaries are the Dulnain on the left, and the Avon on the right.

SPEYER, or SPKIER. See SPIRE.

SPEZIA, a town of Italy, in the province of Genoa, situated at the north-west end of the Gulf of Spezia, at the foot of beautiful and strongly-fortified hills, 50 miles south-east of Genoa. It has one of the largest and safest harbours in Europe, and is now the chief Italian naval station. The naval harbour, royal dockyards, naval arsenal, ship-building yards, marine artillery magazines, Piazza d'Armi or exercising ground, military hospital, and artillery barracks are situated to the south-west of the town proper, from which they are separated by the Viale Savoia. The streets are mostly laid out on the rectangular plan, and there are three or four fine squares, of which the largest is the Piazza Vittorio Emanuele. Among noteworthy buildings in the town are the infantry barracks, the naval barracks, the town-hall, the cathedral, the post-office, the prefecture, the civil hospital, the admiralty, two theatres, and the railway-station. The commercial harbour is much smaller than the naval one, and is situated on the sea-front of the town proper. The new commercial harbour was begun in 1890. The chief imports are coal, wheat, lead ores, and machinery, and the chief exports are lead and marble, but the trade is not of great importance. In and near Spezia there are manufactures of lead, leather, glue, acids, chemical manures, &c., and ship-building is carried on. Vines and olives are extensively grown in the surrounding district. The town is now lighted by electricity. The climate is very mild, and in consequence Spezia is a favourite winter resort for English people. Its sea-bathing is excellent. Pop. (1899), 63,163.

SPEZZIA, or SPETSÆ (ancient, *Tiparenos*) an island of Greece, at the eastern entrance of the Gulf of Napoli, about 3 miles s.s.w. of the coast of Argolis; length, 4 miles; breadth, about 3. Though very rocky it has many patches of soil which are carefully cultivated. A town of the same name stands on the east shore, and has a good harbour. During the Greek war of independence the inhabitants of this island, mostly of Albanian stock, contributed, with those of the neighbouring island of Hydra, most of the ships and sailors of the Greek fleet, and made themselves famous by their exploits at sea. Pop. (1896), 4432, mostly living in the town of Spezzia and engaged in commerce.

SPHAGNUM, a very common genus of mosses, the type and only genus of the family Sphagnaceæ, remarkable for the whitish colour of the leaves. These plants are soft, flaccid, and, when moistened, absorb water like a sponge, but become friable in drying. Both the paleness of their leaves and their great absorptive power are explained by the nature of the leaf-cells. A few small cells containing chlorophyll and active protoplasts are wedged in among a great number of much larger cells without protoplasm. These latter cells have their walls strengthened by spiral thickenings and pierced by many pores. They grow in moist, boggy places, whence their name of *bog mosses*, and are usually saturated with water, often occupying exclusively considerable tracts of marshy ground. The formation of peat in such situations is often owing, in a great measure, to the presence of these plants. They are found in all parts of the globe from the equator to the polar regions. They are excellent for enveloping the roots of plants intended for distant transportation. The common species are *S. cymbifolium*, *S. acutifolium*, *S. cuspidatum*, and *S. squarrosum*.

SPHERE, a solid bounded by a surface which is everywhere equally distant from a certain point called the centre. If an arc equal to a semicircle be made to rotate about the straight line joining its ex-

tremities, it will generate in space a spherical surface. Any section of a sphere by a plane will be a circle; when the plane passes through the centre the circle of section is a great circle; any other section is a small circle. A straight line passing through the centre and terminating at the surface is a diameter; a straight line from the centre to the surface is a radius. The surfaces of spheres vary as the squares of their radii. The area of the surface of a sphere is  $4\pi r^2$ , where  $\pi$  is 3.1416 the circumference of a circle in terms of the diameter, and  $r$  is the radius of the sphere; that is, the area of a sphere is four times the area of a great circle. If a spherical surface be cut into rings by a set of parallel planes, the area of any ring is proportional to the distance between the two planes which determine it, and the area of the ring is to the total area of the spherical surface as the distance between the two planes is to the length of the diameter. The volume of a sphere is  $\frac{4}{3}\pi r^3$ .

**SPHERICAL ABERRATION**, the confusion caused by a spherical mirror at its focus on account of the mirror being spherical and not parabolic. Any right line drawn from the focus of a parabola to the curve, and another right line drawn from the same point parallel to the axis make equal angles with the normal at the point; hence any ray of light parallel to the axis of a parabolic reflector will be reflected accurately to the focus. A small portion of a spherical surface does not differ much from a small portion of a parabolic surface.

**SPHEROID**, a solid generated by the revolution of a semiellipse about its axis when the ellipse does not greatly differ from a circle. A prolate spheroid is generated when the axis of revolution is the major axis; an oblate spheroid is generated about the minor axis.

**SPHEROIDAL STATE**, the name given to the phenomena presented by liquids when placed on a hot surface. Leidenfrost observed that a drop of water placed on a very hot surface assumed a spheroidal shape and did not touch the surface. M. Boutigny made a more thorough study of the subject, and experimented with various liquids. The limit of temperature of the hot surface is the temperature at which the drop of liquid spreads on it and boils with a hissing noise. M. Boutigny places the limit for water at 142° C., and at 61° C. for ether. The temperature of a drop of liquid in the spheroidal state is always below that at which the liquid boils, and for this reason the interesting experiment of freezing a small quantity of water on a hot platinum dish may be performed. The dish is heated to an almost white heat, when a small quantity of sulphurous acid is placed upon it, and assumes the spheroidal state; the boiling point of sulphurous acid is -10° C., and in the spheroidal state it is at a temperature less than -10° C.; a few drops of water added to the sulphurous acid is immediately frozen, and may be thrown out of the dish a mass of ice. Substituting nitrous oxide for sulphurous acid, and mercury for water, mercury may be solidified in the same manner.

In various ways it is made evident that the liquid does not touch the surface, such as making the surface a flat plate and observing that light passes between the spheroid and the plate, or letting a conducting point enter the spheroid from above, and trying if a current of voltaic electricity will pass between the spheroid and the dish. The temperature of the spheroid is kept low by the rapid evaporation which is going on at its surface; the spheroid is kept from touching the dish by a cushion of vapour, and this cushion is non-conducting, so that the heat which affects the spheroid is heat radiated from the dish;

as soon as the temperature of the dish is less than that competent to provide a cushion of vapour sufficiently dense to sustain the spheroid completely from contact with it, the spheroid spreads on the dish and is quickly dissipated by the heat which it now receives by contact.

**SPHINX**, a fabulous monster which figures both in the Grecian and Egyptian mythologies, and was probably of Egyptian origin. The sphinx of the Greeks is represented with a body like that of a lion with wings, and with the breasts and upper parts of a woman. Hēra, says the fable, provoked with the Thebans, sent the sphinx, the daughter of Typhon and Echidna (or of Typhon and Chimera, or of Orthrus and Chimera, Orthrus being himself the son of Typhon and Chimera), to punish them. It laid this part of Boeotia under continual alarms by proposing an enigma, and devouring the inhabitants if unable to explain it. The Thebans were told by the oracle that the sphinx would destroy herself as soon as the enigma she proposed was explained. In this enigma the question proposed was, What animal walked on four legs in the morning, two at noon, and three in the evening. Upon this Creon, king of Thebes, promised his crown and his sister Jocasta in marriage to him who should deliver his country from the monster by a successful explanation of the enigma. It was at last happily explained by Œdipus, who observed that man walked on his hands and feet when young, or in the morning of life; at the noon of life he walked erect; and in the evening of his days he supported himself upon a stick. (See ŒDIPUS.) The sphinx no sooner heard this explanation than she threw herself from a rock, and immediately expired. It was frequently used by the Greeks as an architectural ornament. The Egyptian sphinx does not appear to have been distinguished by the same traits of character. Its form resembled that of the Greek sphinx, but was not exactly the same. It had a human head (male or female) on the body of a lion (not winged), and was always in a recumbent posture, with the fore-paws stretched forward, and a head-dress resembling an old-fashioned wig; while the Greek sphinx is represented in a variety of postures. The features are like those of the ancient Egyptians found in the ancient ruins. It was common among the Egyptians to set up statues of sphinxes before the entrances to temples, one on each side. The largest sphinx with which we are acquainted is that near the group of pyramids at Gizeh. It is about 150 feet long and 63 feet high; the body is monolithic, but the paws, which are thrown out 50 feet in front, are constructed of masonry. The sphinx of Sais, formed of a block of red granite 22 feet long, is now in the Egyptian museum in the Louvre. There has been much speculation concerning the signification of these figures. The fact that some of them have the head of a female and the other parts of a male, has led to the conjecture that they are intended as emblems of the generative powers of nature, which the old mythologies are accustomed to indicate by the mystic union of the two sexes in one individual. It is doubtful whether there was any historical connection between the Greek and Egyptian fables of the sphinx, or whether the Greeks merely applied the term sphinx to the Egyptian statues on account of an accidental external resemblance between them and their own figures of the sphinx. In hieroglyphics the sphinx is called *neb*, which is still used in Coptic with the signification of 'lord' or 'master.'

**SPHINX-MOTH** (*Sphinx Convolvuli*), sometimes also named the Unicorn Hawk-moth, a species of Lepidoptera or Moths belonging to the family Sphingidæ, and deriving its popular name from a sup-

posed resemblance which its caterpillars present when they raise the fore part of their bodies to the mysterious 'sphinx' of Egyptian celebrity. The family characters are found in the very long proboscis, in the small hinder pair of wings, and in the body being long and pointed posteriorly; whilst the genus *Sphinx* itself is distinguished by the antennæ not being club-shaped, and by the wings having sharp outlines. The Sphinx-moth is found very sparingly throughout England. It is nocturnal in habits, its caterpillar feeding chiefly on the Convolvulus or Bindweed, and from this habit the specific name of the moth is derived. The larva is coloured green, spotted with black and brown, and striped obliquely on each side with yellow stripes bordered with black. A curved horny process exists on the tail. The wings of the adult moth are brownish, marked with gray and white, the abdomen being marked by reddish or pink bands, and with black stripes. A central gray mark runs down the centre of the body. Allied species are the Privet Hawk-moth (*S. Ligustri*) and the Pine Hawk-moth (*S. Pinastri*).

**SPHYGMOGRAPH** (Greek, *sphygmōs*, the pulse, and *graphō*, 'I write'), an instrument for recording the movements of the pulse. Sanctorius, an Italian physician who died in 1636, is credited with the invention of an instrument for measuring the arterial pulsations, but what the nature of this instrument was is not known. In 1834 Hérisson invented an instrument for the same purpose. This instrument consisted in a tube partially filled with mercury, and closed at the bottom by a delicate membrane. The pulse being placed under this column of mercury, the membrane in contact with the skin, the rise and fall of the mercury in the tube indicated the beats. But the first true sphygmograph or recording instrument was the invention of Vierordt, which has received various improvements at the hands of Marey and Longuet. In its most improved form this instrument consists of a small rod which moves vertically up and down, and in so doing communicates motion to a thread passing round two horizontal movable axes, one of which moves a needle which serves as an index, while the other moves a wheel. A pen held in a jointed stalk follows the movements of this wheel, and records its motions on a strip of paper, which is passed beneath it by clock-work. The record has the appearance of a more or less irregularly undulating line. At the lower end of the vertical rod is a small plate, rounded on the lower surface, and when the instrument is in use this plate is brought into contact with the skin above the pulse, which is kept in position by a rest supporting the wrist. Before the instrument is set in full operation the position of the pulse is slightly varied until it is ascertained in what position it gives the strongest impulse to the vertical rod, which is indicated by the index needle on a graduated scale. See Dr. Sander-son's Handbook of the Sphygmograph.

**SPICE ISLANDS.** See **MOLUCCAS**.

**SPICES**, the name given to all those vegetable substances, mostly of foreign origin, having an aromatic odour and a hot and pungent flavour, and used for seasoning food. Cinnamon, cassia, mace, nutmeg, allspice, pepper, cloves, ginger, vanilla, are examples of the principal foreign spices; and cumin, coriander, caraway, fennel, of the native or naturalized vegetable products to which the term is applied. They are obtained from different parts of the plants yielding them; some being the fruit or the kernel or other part of the fruit, some the outer or inner bark, some the root-stock. They owe their odour and flavour to the essential oils they contain. Formerly all foreign

Egypt, and even yet the great majority of them are of eastern origin, although several are also obtained from America and the islands situated within the tropics.

**SPIDER**, the name given to numerous genera of Annulose animals belonging to the class Arachnida. This class is distinguished by the fact that the head and chest are united to form one division or *cephalothorax*; the breathing is conducted by means of pulmonary or lung sacs, either without or in conjunction with tracheæ or air-tubes; no wings are developed; and no antennæ or feelers, as such, are represented, these organs being probably replaced in Arachnida by the *mandibles* or large jaws. The Spiders themselves form a very distinct order, Araneida or Sphærogastera, of the class Arachnida. This order is distinguished by the abdomen being soft and unsegmented, and by its being attached by a narrow neck to the thorax or chest. The breathing organs exist in the form of pulmonary sacs in combination with air-tubes. These sacs number either two or four, and open on the surface of the abdomen, each by a definite aperture or *spiracle*. Each sac consists essentially of an involution of the skin or integument, in which a large number of flat lamellæ or plates are situated with their flat surfaces placed together like the leaves of a book. On these plates the pulmonary blood-vessels ramify, and in these vessels the blood is subjected to the action of the aerating atmosphere admitted to the sac through its spiracle. The head bears simple eyes only, these numbering from six to eight. The mandibles or large jaws are hooked, the hooks being perforated by a canal which is continuous with the duct of a poison-gland, this structure constituting the offensive apparatus of the class. The palpi of the maxillæ or lesser jaws are never *chelate*, or provided with pincers, as in the Scorpions. One of the most characteristic features of Spiders as a whole is found in the possession of a spinning-apparatus, whereby they are enabled to construct a web or net of various kinds, used in the capture of their prey. The special silk-glands, furnishing the silk secretion wherewith to construct the net, are situated at the extremity of the abdomen. These glands secrete a viscid fluid, which becomes more tenacious when exposed to the air, and can then be drawn out in the form of fine silky threads. The thread-like shape is given to the secretion by its being pressed through certain tubular organs named *spinnerets*, which are also situated at the extremity of the abdomen. The spinnerets number four or six, each consisting of a little cone or cylinder, the apex of which is perforated by numerous small apertures or holes. Pressed through these holes, the silk-secretion appears in the form of numerous fine threads, whilst the threads of the various spinnerets are finally united to form the single thread with which the spider constructs the net. Thus, if we consider the delicate nature of this single and compound thread, we may form some estimate of the exceeding delicacy of the separate threads of which it is composed. The feet and maxillary palpi appear to be the organs with which the web is fixed in its place and constructed, and very great variations exist not only in the form, but also in the uses to which the web may be put. The reproductive process in Spiders has formed a subject of much interest to naturalists, from several anomalous features which it presents. The female spiders are much larger and fiercer than the males. The sexes are invariably distinct. In the males the palpi or feelers of the maxillæ or lesser jaws have their extremities specially modified for the storage and conveyance of the male or fertilizing fluid to the female organs of reproduction. The testes or male organs themselves are situated within

the abdomen, and it is believed that the males may take the semen from the testes, store it in their maxillary palps, and thus fertilize the eggs of the female. The young do not pass in the course of their development through any defined metamorphosis (which see), such as is so well exemplified in the case of the Insects; but repeated processes of *ecdysis* or moulting of the skin appear to take place during the growth of the young Spiders. In their habits Spiders are invariably predaceous and carnivorous, and exhibit, as is well known, much skill and ingenuity in the capture of their prey. Their nervous system, indeed, is of a more concentrated type than that of insects, and is thus better adapted to the psychical wants of creatures which prey upon other forms. The digestive system also appears to exhibit a comparative simplicity of structure, and is thus adapted for assimilating the food, which consists chiefly of the easily-digested juices of their prey. The entire body in Spiders consists of about twenty segments, six of these joints composing the head. The order Araneida includes a large number of genera and species. It has been divided into sub-orders by the number of eyes. Thus the Octonoculina possess eight eyes, and these eyes are variously disposed on the head in the various genera of each sub-order. In this first sub-order the chief families are those of the Mygalidæ (with four spinnerets), Lycosidæ (with six spinnerets), Salticidæ (six), Thomisidæ (six), Drassidæ (six), Cnifionidæ (eight), Agelenidæ (six), and Epeiridæ. The sub-order Binoculina includes Spiders with but two eyes, whilst the Senoculina possess six. Of the first group the family Epeiridæ includes the more familiar forms. The Common Garden Spider (*Epeira diadema*, figured at ENTOMOLOGY, Pl. III., fig. 56), with its geometrical web, is a very familiar species. The abdomen is marked on its dorsal surface with a triple yellow cross. *Epeira bicornis* is another well-known form. The family Mygalidæ (fig. 54) includes several famous species. The Great Crab Spider (*Mygale cancerides*), and the *M. aricularia* of Surinam, alleged to feed on small birds, are notable forms. To this family also belong the Trap-door Spiders (*Cteniza*, fig. 55), of which the *C. nidulans* of Jamaica is a familiar species. These latter excavate a nest in the ground, and fit to the aperture a curious little door or lid, which accurately conceals and closes the entrance to their abode. The Tarantula (*Lyrosa Tarantula*, fig. 52) belongs to the family Lycosidæ or Wolf Spiders, which are terrestrial in habits. This form is notable as being regarded in Italy as capable of producing a kind of dancing madness by its bite, which music of a particular kind was believed to have the power of curing. *Lyrosa saccata* and *L. andrenivora* are allied species. The English Hunting or Zebra Spider (*Salticus scenicus*, fig. 57, 58) is a pretty little Arachnid. The *Clotho Durandii*, belonging to the family Drassidæ, inhabiting Spain and North Africa, is remarkable as constructing a kind of little tent, in the interior of which the eggs, inclosed in little pouches, are contained. The entrance to the tent is concealed in such a manner that the spider herself alone can gain admittance to her home. The interesting Water Spiders (*Argyroneta aquatica*), familiar denizens of our fresh-water pools, lead a subaqueous life, and construct their nests somewhat in the form of diving-bells with the mouth opening downwards, together with thin webs in which their prey is captured. The Water Spider being, like all other members of its class, an air-breather, is forced to carry down with it into the depths of the pool supplies of atmospheric air, and the spider may thus frequently be seen descending to its abode carrying a clear bubble of air attached to and entangled in

the hairs with which its abdomen is clothed. This air, as in an actual diving-bell, displaces the water, and thus keeps the interior of the curious abode perfectly dry. The eggs of this species are contained within little cocoon-like cases. The colour of the Water Spider is brownish, mottled with red tints. The species of the genus *Tegeneria* are domestic spiders, of which *T. domestica* is the most familiar member.

SPIDER-CRAB (*Maia*), a genus of Crabs or Brachyura, included in the family Maiada, and deriving their popular name from the rough general resemblance their bodies possess to those of spiders, the elongated legs assisting this resemblance. This family is distinguished by its members possessing moderately long legs, and by the basal joint of the outer antennæ being of large size. The typical genus *Maia* itself is recognized by possessing an oval body and a prominent beaked process or rostrum in front of the body. The first pair of legs is hardly larger than the other limbs, and the rudimentary abdomen possesses seven joints. The *Maia squinado*, or Common or Thornback Spider-crab, is a familiar British species, and exhibits its carapace or back covered with numerous small pointed processes. It is very commonly taken in the crab-pots of fishermen. The Great Spider-crab (*Hyas araneus*), sometimes also termed the 'Sea-toad,' belongs to a different genus (*Hyas*), distinguished by the wide flattened carapace and by the first joint of the base of the outer antennæ being flat and wide. The Four-horned Spider-crab (*Arctopis tetradon*) has a triangular body, possessing four horn-like processes in front, the two central ones forming the rostrum or beak. The abdomen is seven-jointed. The colour in this latter species is yellow. The Three-spined Spider-crab (*Pericera trispinosa*) is known by the lateral antennæ being inserted under the beak. The front part of the carapace presents an arrangement of triple spines, from the presence of which the familiar name of this species is derived. This latter crab occurs in the West Indian Seas and at the Philippine Islands. (See Plate at CRUSTACEA, fig. 10.)

SPIDER-MONKEY, a general name applied to many species of Platyrrhine or New World Monkeys, but more especially to the members of the genus *Ateles*, in consequence of the great relative length of the limbs and tail, and from the agility of these monkeys in leading an arboreal or tree life. These monkeys (as in all Platyrrhina, which see) possess broad nostrils and very long prehensile tails. The tail, indeed, serves as a fifth hand in its usefulness in grasping the branches of trees. No cheek-pouches exist, and the thumb, when present, is placed at a different level from the fingers. The head in the genus *Ateles* is rounded and small; the thumbs are wholly wanting, the tail being destitute of hairs on the under surface at its tip. The name '*Ateles*' is in fact derived from the absence of the thumbs. A familiar species is the Chameek (*Ateles Chameek*), which has a rudimentary thumb, and which occurs abundantly in Brazil. The body is about 20 inches, and the tail 2 feet long. The colour is a general black. The Coaita (*Ateles paniscus*) is another and most typical species of Spider-Monkey. (See Pl. at APE, fig. 12.) The tail in this latter species is very long, and endowed with remarkable prehensile powers. Its average length is 12 inches, and the tail measures over 2 feet long. The fur is of a dark, glossy, black hue. The Marimonda Monkey (*A. Belzebuth*) is a third form, which exists largely in Spanish Guiana, and exhibits a general deep black colour of fur. The genus *Brachyteles*, of which the Miriki Monkey (*B. hypoxanthus*), or Mono of Brazil (fig. 7), is a familiar example, also includes forms

named Spider-monkeys. The thumb is better developed than in the genus *Ateles*.

**SPIKENARD**, or **NARD** (*Nardostachys*, *Nardos*), a perfume highly valued by the ancients, and also the plant from which it was obtained. This plant, upon evidence first adduced by Sir William Jones, and confirmed by two of the greatest of Indian botanists, Dr. William Roxburgh and Dr. Forbes Royle, is now identified with a plant belonging to the Valerian family. After its discovery this plant was at first considered as belonging to the genus *Valeriana*, but was separated from this genus by De Candolle, and is now known to botanists as *Nardostachys jatamansi*. It is a native of the mountainous districts of Nepal. The living plant was first found and sent home by Dr. Wallich, and soon after Dr. Royle succeeded in raising it in the botanic gardens at Saharunpur, at the foot of the Himalayas. It is well distinguished by its stems or roots above ground clustered together, of a bright blackish colour, with a shaggy covering, suggestive of the tails of ermines, and occasioning the Sanskrit name signifying 'locks of hair,' which has been adopted as its specific name by botanists. Various species of Valerian, which were used by the ancients as substitutes for the true Indian spikenard, were also called by that name. Such were the Gallic or Celtic Spikenard (*Valeriana Celtica* and *Valeriana salinauca*) and the Cretan Spikenard (*Valeriana Italica*, *Valeriana tuberosa*, and *Valeriana phu*). All these grow on almost inaccessible parts of the Alps and other mountains of Southern Europe, where they are still collected by the peasantry and sold to merchants, who obtain high prices for them in Turkey, Egypt, and the East, where they are used as cosmetics, and by those who can afford them are employed in scenting baths. The true Indian spikenard is highly esteemed throughout the East in the present day, as it was in ancient times, both as a perfume and as a medicine, although its odour is usually found to be disagreeable to Europeans. In the United States the name of spikenard is given to the *Aralia racemosa*, which yields a fragrant gum-resin.

**SPIKE-SHELL** (*Crescis aciculata*), a genus of Pteropodous Mollusca (see MOLLUSCA), found usually near masses of floating sea-weed, and so named from the sharp-pointed conformation of the shell.

**SPIKING**, a mode of rendering cannon of the old type useless, resorted to when they are likely to fall into the hands of the enemy, or when the enemy's cannon have been captured in circumstances which render it impossible to carry them off. It consists in driving a spike into the touch-hole. When the spiking is intended to be only temporary a spring spike may be used, which may afterwards be released by the stroke of a hammer. In other cases the spike is driven well home in such a manner that it cannot easily be extracted. When a brass cannon has been spiked it is sometimes found possible to extract the spike after pouring sulphuric or nitric acid on it to loosen it; and from an iron cannon it is sometimes expelled by loading the cannon with a double charge of powder and ball, and firing by a train laid from the muzzle. If such methods fail the only way to render a spiked gun again serviceable is to drill a new touch-hole.

**SPINAGE** (*Spinacia oleracea*; natural order, Chenopodiaceae). This plant is a native of Persia, and has been cultivated in Europe as an esculent for above two centuries. The root is annual; the stem herbaceous, smooth, upright, a foot or more high, and somewhat branching; the leaves alternate, petiolate, and arrow-shaped; the flowers small and greenish, disposed in several little bunches in the axils of the superior leaves, and dioecious. It is eaten sometimes

in salads, but more frequently cooked in various manners. It is a wholesome and agreeable aliment. The plant is of the easiest culture and may be procured nearly all the year round by sowing at intervals of time. It requires a rich soil, and frequent watering in dry weather.

**SPINAL CORD**, the name given in anatomy to the great cord or rod of nervous matter which is inclosed within the back-bone or spine of Vertebrates, and which may be viewed as a continuation downwards of the brain. The spinal cord, or *spinal marrow*, as it is also named, along with the *brain*, forms the chief nervous centre of the Vertebrate body, this centre being hence termed the *cerebro-spinal nervous axis*, as distinguished from the *sympathetic system* (which see) of nerves. The spinal cord is thus firstly seen to be protected within the spine itself, the canal or tube in which it lies, and which is formed by the apposition of the neural arches of the vertebrae, being named the *neural canal*. In man the spinal cord does not wholly occupy this canal, but is invested by its *meninges* (which see), or membranes like the brain, consisting firstly of the *dura mater*, which lies to the outermost side, and which forms a complete canal loosely surrounding the spinal cord, and sending off prolongations around the spinal nerves, which originate from the cord. Secondly and intermediately, of the *arachnoid membrane*, continuous with that of the brain, and consisting therefore of two layers—a *visceral layer* surrounding the spinal cord, and a *parietal* one lining the inner surface of the *dura mater*; and thirdly, of the *pia mater*, forming the innermost layer, and immediately investing the spinal cord. The arachnoid membrane is separated from the pia mater by a layer of watery fluid contained within the meshes of the subarachnoid tissue, and known as the *cerebro-spinal fluid*. This fluid was first discovered by Haller, the great physiologist, and communicates apparently with the fourth ventricle of the brain. In amount it varies from 1 to 2 oz. or more, and may be made to flow from the brain into the spinal cord, or *vice versa*. The pia mater sends delicate prolongations of its substance into the *fissures* of the spinal cord, and from the second lumbar vertebra it is continued downwards in the form of a slender filament, termed the *filum terminale*, which supports the numerous branches into which the spinal cord ultimately and at its lower portion divides. The pia mater also gives off from 18 to 22 pairs of processes along the length of the cord from a fibrous band which it forms, and which is known as the *ligamentum denticulatum*. The spinal cord itself begins at the *medulla oblongata* of the brain, and may be measured as extending from the *foramen magnum* (see SKULL) to the upper part of the second lumbar vertebra, at which latter part it terminates in a pointed manner, having previously given off the great nervous branches known collectively as the *cauda equina*, and which supply the lower limbs. The spinal cord measures from 17 to 18 inches in length. In form it is cylindrical, and exhibits a slight flattening from before backwards. It presents an enlargement in its diameter at the root of the neck, and again in the lower dorsal or back region, at the point where certain large nerves arise. It is divided into two equal halves by a fissure in front (*anterior fissure*) and by a corresponding cleft behind (*posterior fissure*). The front fissure is the deeper, and extends into about one-third of the substance of the cord. The pia mater dips into this fissure, and supports blood-vessels for the nutrition of the front part of the cord. In the floor of the anterior fissure a layer of white nervous matter, known as the *anterior commissure*, connects the two front halves of the spinal cord. The hinder

fissure is not an actual fissure like the anterior, but is merely a process of connective tissue which clearly marks off a right from a left half of the cord. The cord is also marked along each half by two grooves of superficial character, from which the spinal nerves emerge. These grooves are named *anterior* and *posterior lateral grooves*, and by them the cord is divided in each of its halves into three vertical columns, which are respectively named *anterior*, *posterior*, and *lateral*. It may here be noted that the anterior columns are *motor* in their functions, the posterior are *sensory*, and the lateral are both *motor* and *sensory*. If the spinal cord be divided across, its structure is seen to comprise an external layer of *white nerve-matter* and an internal layer of *gray matter*, the latter being arranged in the form of two crescents, one of which exists in each half of the cord. These gray crescentic parts are connected by a band of nervous matter termed the *gray commissure*. The crescents thus exhibit horns (*cornua*) or processes, their posterior cornua being long and narrow, and extending to the posterior lateral fissure; whilst their anterior cornua are thicker and shorter, and extend forwards to the anterior roots of the spinal nerves.

As a nerve-centre the spinal cord gives off certain (*spinal*) nerves, which number thirty-one pairs; eight pairs belonging to the cervical or neck region, twelve to the dorsal or back region; five to the lumbar, five to the sacral, and one pair to the coccygeal region. Each spinal nerve originates from the cord by two distinct sets of *roots*, one set originating from the anterior and the other from the posterior part of the cord. It was Sir C. Bell's great discovery that the anterior roots of the spinal nerves were exclusively composed of *motor fibres* (see NERVE), whilst the larger posterior roots were as exclusively made up of *sensory fibres*. These various fibres, differing in function, unite shortly after leaving the spinal cord to form a single nerve in each case on each side of the spine, and pass outwards through the *intervertebral foramina*, or apertures, to be distributed in the body. On each posterior root before it unites with its corresponding anterior root is a nervous *ganglion* or mass of nervous matter, of oval form, and which lies in the foramen above noted, through which the nerves emerge from the spine. Outside the spine the compound nerve-trunk, thus formed by the union of the anterior and posterior roots, divides into an anterior and a posterior branch. The spinal cord is supplied with *blood-vessels* by the *anterior spinal artery*, and by the *posterior artery* of the same name, these being derived from the *vertebral*, *intercostal*, and *lumbar arteries*. The veins of the cord are remarkable for their number and tortuosity. They consist of the *dorsal veins*; of those from the bodies of the vertebrae; of the *anterior and posterior longitudinal spinal veins*; of the *veins of the cords proper*. The veins of the spinal cord are entirely destitute of valves. Regarding the interesting subject of the *functions* of the spinal cord, these have in part and in a general sense been noted in the article NERVE (which see), in speaking of *nerve-centres*. The spinal cord, like other nerve-centres, is capable of *originating*, *conducting*, *diffusing*, and *transferring* nervous impressions to and from the parts which its nerves supply. The anterior columns and their corresponding nerves, consisting of *motor fibres*, carry the impressions (direct or reflex) of the will *outwards* and *from* the cord to muscles, and so produce movements; whilst the posterior columns, being exclusively sensory in function, carry impressions to the gray matter of the cord as a centre, where these impressions again are received and acted upon or transmitted elsewhere. The gray matter of the cord thus receives impressions,

and if required transmits them to the brain, where if perceived by the intelligence or mind they produce sensations. That the spinal cord acts itself as a *centre* is shown in cases in which the cord is divided or injured; when, although impressions cannot be sent upwards to the brain, the parts of the body *below* the division will remain subject to the influence of the lower and intact part of the cord. Impressions are *radiated* or diffused from the spinal cord as a centre, as is well shown in the convulsions of children, when irritation due to undigested substances in the bowel passing to the spinal cord throws numerous centres into spasmodic activity, the irritation reaching a limited region of the cord first, but overflowing to adjacent parts. In modern physiology the spinal cord is regarded as in reality made up of a series of ganglia or nerve-centres, united to form a single column, and this generalization is rendered the more feasible from the observations of Volkmann and others, which demonstrate that certain parts or segments of the cord appear to act as *independent centres*, and that certain muscular actions of limited kind appear to be under the control of circumscribed portions of the cord. In the action of the *lymphatic hearts* (see LYMPH) of the frog, the anterior pair of these organs, for example, has been found to depend for nervous supply and action upon a limited part of the cord, corresponding to the third vertebra of the animal's spine.

It may lastly be noted that the name *central canal* of the spinal cord has been applied to indicate the small canal or tube which exists in the centre of the gray matter of the cord, which extends throughout its entire length, and which in all probability represents the canal or primitive tube appearing in the early life of the embryo. See also NERVE.

SPINDLE-SHELLS, the name given to several genera of Gasteropodous Mollusca (which see). The Beaked Spindle-shell (*Rostellaria curvirostris*) is coloured chestnut with yellow tints; the beak is white inside and edged with black. The average length is 4 inches, this species occurring in tropic seas. The Common Spindle or Distaff Shell (*Fusus conus*), belongs to a different genus of Gasteropoda—that of the Whelks. The Giant Spindle (*Fusus colossus*), a very large Gasteropod, is another species.

SPINDLE-TREE (*Euonymus*), a genus of small trees or shrubs belonging to the natural order Celastraceæ. The leading species are from 10 to 30 feet in height. They are chiefly deciduous. Their blossoms, which are produced in the beginning of summer, are of a colour resembling that of their leaves, and by no means attractive. In autumn, however, the seed-vessels or capsules appear in great profusion, of the most delicate colours, generally pink or white; when ripe they expand and show the seeds, or rather the arils, of a rich yellow colour, inclosing the seeds. Thus the contrast of colours, and the length of time the capsules hang on the trees, render them highly ornamental during the season. The Common Spindle-tree (*Euonymus Europæus*) is found wild in Britain, in France, and throughout the north of Europe. It is remarkable for producing a compact mass of white fibrous roots, which retain the soil and fit it for being successfully removed at any age or size. The wood is very valuable, of a white colour, finely grained, and hard. It was once esteemed as a material for musical instruments, netting-needles, and spindles, and hence its name. It is still sought after in the manufacture of the finer articles of turnery and of skewers. The seed and capsules are used by dyers in the production of various colours. The Broad-leaved Spindle-tree (*Euonymus latifolius*), a native of France, Germany, and Switzerland, is perhaps the handsomest tree of the genus. The leaves are broad and shining, and the fruit highly ornamental.

**SPINE**, the name applied popularly to the *backbone* or *vertebral column*, consisting of bones named *vertebræ*, and found only in the highest sub-kingdom of animals (*Vertebrata*), which is represented by fishes, amphibians, reptiles, birds, and mammals, including man. The spine is first formed at an early stage in the life of the vertebrate embryo, by the appearance of the structure known as the notochord (which see) or *chorda dorsalis*, which is a cylindrical tube containing embryonic cells, and lying in the floor of the primitive groove or canal, in the dorsal or back aspect of the embryo. The first or rudimentary *vertebræ* appear as square-shaped masses developed on each side of the notochord. These masses grow larger and extend themselves by the growth of *processes* so as to inclose the spinal canal; and as development proceeds, these primitive *vertebræ* divide to form the permanent bones of the spine, whilst the notochord in the adult comes to be represented by the matter (*intervertebral cartilages*) which lies between the bodies of the fully formed *vertebræ*. *Cartilage* begins to be developed in the primitive *vertebræ* of the human subject as a prelude to the growth of *bone*, about the sixth or seventh week of development. The adult spine in man consists of twenty-six bones, of which two—*sacrum* (which see) and *coccyx*—are respectively compound, in that the first consists of five *vertebræ* united to form a single bone, whilst the latter consists of four or five separate but in the adult united bones. In length the spine averages 2 feet 3 inches, the neck part measuring 5 inches, the back 11, the lumbar 7, the sacrum and *coccyx* making up the remaining length. It forms the foundation of the skeleton, and is situated in the middle line at the posterior part of the trunk of the body. The spine of man exhibits, when viewed from the front, two pyramids joined by their bases, the upper pyramid being formed by the *vertebræ* from the second cervical (or neck) to the fifth or last lumbar (*loins*), whilst the lower pyramid is formed by the *sacrum*—itself of conical shape—and *coccyx*. The spine of man is curved, and so adapted for sustaining his body in the erect posture. (See *MAN*.) The uppermost curve begins at the summit of the *neck* and ends at the middle of the second dorsal *vertebra*. This curve bulges out anteriorly. The dorsal or second curve begins at the second dorsal *vertebra* and terminates at the middle of the twelfth or last dorsal segment. This curve constitutes the natural 'hollow of the back,' and is therefore concave anteriorly; whilst the third curve is that of the *loins*, and is convex anteriorly; the last or pelvic curve, represented by the *sacrum*, being concave anteriorly,—that is, taking the word anteriorly, as thus used, to indicate the front aspect of the spine or that which lies next the internal surface of the body. This anterior or front surface of the spine exhibits the bodies of the *vertebræ* separated by plates of cartilage—the *intervertebral discs*. The bodies of the *vertebræ* are broadest in the lumbar or *loins* region, and narrowest, as a whole, in the dorsal portion. The posterior surface of the spine presents us with the prominent *spinous processes* of the *vertebræ*, which, growing broader and stouter as we proceed downwards, gives to the backbone the *spinous aspect*, from which indeed the name *spine* has itself been derived. The sides of the spine present articular and transverse processes. The canal for the protection of the spinal cord (which see), formed by the apposition of the *vertebræ*, is widest in the neck and *loins*—these being the regions where the greatest freedom of movement exists—and narrowest and of more rounded shape in the back region. In man seven cervical (neck), twelve dorsal (back), and five lumbar (*loins*) *vertebræ* exist, the *sacrum* and *coccyx* forming the base of the spine.

Thus thirty-three *vertebræ* in all may be accounted as forming man's spine, and, except in some rare cases, no supernumerary *vertebræ* are developed. Each *vertebra* consists of a *body*, which gives origin posteriorly to an *arch* (inclosing a segment of the spinal cord), whilst behind the arch gives origin to the *spinous process*. In addition to this latter process the *vertebra* bears four *articular* and two *transverse* processes. The former of these two sets of processes are those by means of which the *vertebra* articulates with its neighbours, whilst the transverse processes and *spinous process* serve for the attachment of muscles. The *atlas vertebra* is the name given to the first cervical or neck *vertebra* which supports the skull (which see). It has no body or *spinous process*, and, together with the head, moves or rotates upon the second or *axis vertebra*, which latter is known at once by its prominent pivot or *odontoid process*, forming the chief *point d'appui* in the movements of the head. The dorsal *vertebræ* give attachment to the ribs (which see), and are distinguished by bearing *facets* or spaces to which the heads of the ribs are attached. The lumbar segments are larger than those of the preceding regions. The *sacrum* has already been described in the article of that name. The *coccyx* of man, representing in itself the *caudal* or *tail vertebra* of lower forms, is made up of rudimentary *vertebræ*, the upper three of which usually present rudiments of transverse and articular processes.

In other *Vertebrata* the *spine*, viewed both as to its several constituents and as a whole, presents very many and wide variations from the human type of structure. The *Amphioxus* or *Lancelet* (which see), at once the lowest fish and *Vertebrate*, has no spine, but simply a notochord, which retains throughout the life of the animal its embryonic condition. And in such fishes also as the Sturgeon, *Lepidosiren*, and *Lampreys*, the backbone is essentially notochordal in its aspect. In other fishes (for example, *Sharks*, *Rays*, &c.) the spine, whilst presenting an advance on the previous condition, is not wholly bony, but is chiefly *cartilaginous*. In *Vertebrates* above fishes the spine is bony, and (as in the extinct *Glyptodon*) its various bones may be found united into one solid mass. In serpents the separate *vertebræ* are connected by ligamentous sacs only. The *form* of the *vertebræ* may also vary greatly. Thus those of fishes are (with one exception) *amphicelous*, that is, biconcave or hollow at either end, whilst *procelous* (concave in front and convex behind), and *opisthocelous vertebrae* (the reverse of *procelous*) are also found. In some sharks eleven times as many *vertebræ* as exist in man's spine may be found; and some serpents (which see) have still more numerous spinal segments. See also articles, such as *ORNITHOLOGY*, *ICHTHYOLOGY*, *REPTILIA*, &c. in which the spine and skeleton generally of the various groups of the *Vertebrata* are described.

The subjects of *spinal distortions* and of *spinal disease* are amongst the most important which can fall to the consideration of the medical man. Injuries and concussions of the spine, from their effects upon the spinal cord (which see), become of grave nature in many cases; and as after cases of railway accidents the shock to the spine may result, frequently after months of apparent health, in the production of serious lesions—the insidious nature and undetermined causes of these injuries forming some of the most unsatisfactory aspects of these cases. Distortions of the spine are almost invariably of congenital nature, and through disease—such as *caries* or bone decay—of the *vertebræ* may produce very great deformities, appearing in the form of 'hump-back,' distorted gait, &c. In the upbringing of children special attention should be paid to the cure of the common *weakness* of the spine—a disorder which, if

left unheeded, may sometimes degenerate into more serious forms of spinal complaint. The correction of stooping habits in children, and attention to the bracing of the body, and to the free exercise of the chest in the movements of respiration, should first begin by attention being paid to the spine. Frequent ablution with cold water—the child being gradually inured to the use of the cold bath or douche—is one of the most strengthening forms of simple treatment for functional weakness of the spine in both young and old. When the vertebrae actually suffer from disease, and the spinal structures are themselves affected, the case becomes more serious, and demands careful medical treatment. For disease of the vertebrae causes the bone to break down. It subsequently yields to the pressure from above, and thus bending or curvature is produced. The distorted spinal column, by pressure on the spinal cord within it, gives rise to various nervous affections, of which paralysis of the lower limbs is not an uncommon form, and may, if not early attended to, become permanent. The muscles of the back, situated on both sides of the spine, which are equal in number and form, and are destined not only to execute the manifold movements of the trunk, but also to maintain, by the equilibrium of their power, the straight direction of the spine, frequently occasion distortions, by losing their vigour; for the spine, in this case, wanting its natural support, inclines sideways or backwards. The same effect may be produced by too frequent or too continued use of one set of muscles in a particular way, for the spine becomes at last permanently fixed in the posture which it has been compelled to assume during the exercise. This survey shows us the various causes of distortions and the proper means for preventing them. The causes may be reduced to diseases and injudicious habits. The diseases of children which may occasion distortions of the spine are chiefly *scrofula* and *rickets*, so often connected with it, and *general debility*. These diseases may be best prevented by the use of wholesome, easily digested food, by pure air, hard beds not too warm, frequent exercise, great cleanliness, frequent bathing, washing, and rubbing the skin, and similar requisites of a good physical education. The muscles of the back are often debilitated by compelling children, particularly weakly ones, to sit up in a constrained posture, which distresses the spine and produces a sinking and bending in search of relief; or by allowing children too little free movement and exercise and obliging them continually to sit still and read—the surest mode of producing physical and intellectual cripples. The use of corsets also contributes much to the weakness of the dorsal muscles, and consequently to distortion of the spine. If the shoulders are continually supported artificially by a corset the dorsal muscles, destined by nature to keep the spine straight, remain inactive and lose their power, the body becomes unable to support itself without the corset, and a sinking and bending take place as soon as it is removed. If to this is added the continual command, perhaps accompanied by threats, to sit straight, which has become actually impossible to the child, its exertions result in nothing but a curvature of the spine, so frequently seen in girls of the higher classes, while in boys of the same families, who are neither tormented with corsets nor admonished so repeatedly to sit straight, distortion is much rarer. The second cause of distortions—*injudicious habits* in the physical education of children—deserves particular attention, because much may be done to prevent them. The habit of many nurses to carry children always on the same arm accustoms the child to incline always towards one side, and to sleep in one position, from which habits a distortion of the spine naturally

arises in the course of time. The awkward position of the body in some amusements and occupations, for instance, the manner in which young people sit in writing, reading, drawing, sewing, embroidering, playing on the flute, violin, harp, and guitar; the habit of crossing the feet in standing or of standing on one foot; the habit of lying crooked in bed, and even the habit of girls to spend a long time in a constrained position dressing their own hair, may occasion distortion of the spine. Every one-sided motion, often repeated, may produce a tendency to such distortion, and, the tendency once existing, the evil increases every day. This distortion, besides disfiguring the body and unfitting the subject for certain avocations, also induces liability to inflammation of the lungs, dropsy of the chest, pulmonary consumption, apoplexy, a general disturbance of the health, and early death. With women it often gives rise to painful labours, and sometimes makes a natural delivery impossible. The proper means of guarding against distortion we have already suggested in the directions respecting food, air, exercise, and cleanliness, the prevention of ill habits on the part of nurses and of the children themselves, and in the important rule not to compel a straight carriage of the body by the wearing of corsets, nor by the continual injunction to stand and sit straight, as both tend directly to produce the evil intended to be prevented. It is important to detect a distortion of the spine as early as possible; and it is therefore the duty of mothers and governesses to examine often the bodies of children. The child should be undressed, and placed in such a way (not lying down) that the entire back may be seen. The head must be held straight, the face directed forwards; the arms must hang down, and the whole position must be as easy as possible. Then the vertebrae must be struck slightly with the hand to discover if there is a prominence or a sensation of pain in any place. The examiner should then proceed to the parts of the body on each side of the spine, which ought to be perfectly equal. The neck, the shoulders, and the hips are to be looked at: if the latter are uneven the hip joints and feet must be also tried. The examiner should also see whether the breast-bone be precisely in the middle of the breast, and whether it forms a straight line, whether the clavicles are uniform, and whether the ribs lie even. With grown girls the unevenness of the breasts often furnishes the earliest sign of distortion of the spine. These examinations ought to be made at somewhat short intervals, and in the case of girls even after they have arrived at maturity, because the years immediately succeeding the period of puberty are those in which distortions are most frequently manifested in the female sex, and because a cure can be hardly expected much after the twentieth year. Attention to distortion ought not to be delayed until a high shoulder or hip shows itself; these are only proofs of a distortion which has already long existed. If, however, anything like distortion is perceived, it is useless to resort to the means so often recommended of suspension by the arms, or the use of plasters, which can avail nothing; and do not expect that the dancing-master can remedy the evil, which will only increase under his lessons. Assistance can be rendered only by a physician familiar with these deformities, and who has made himself acquainted with the general state of body of his patient by a careful examination. The cure must not be expected too soon; and the orders of the physician must be scrupulously obeyed. Too much reliance is not to be placed on the use of mechanical supports and apparatus.

SPINE-FOOT, a well-known genus of *Lacertilia*, or Lizards (*Acanthodactylus*), sometimes known by

the distinctive name of Cape Spine-foot, and so named from the spinous appearance of the toes, which are 'keeled' beneath, and possess fringed edges. This lizard is coloured with brown hues above, the top of the head being dark brown.

**SPINELLE**, or **SPINELLE RUBY**, a kind of mineral. The primary form of this species is the regular octahedron; and this is the figure under which it generally occurs. It is rarely modified by the truncation or the bevelment of its edges, and sometimes presents itself in hemitrope crystals. Its crystals vary in dimensions, though they are usually not above the size of a pea. Their cleavage is very difficult; fracture conchoidal; lustre vitreous; colour red, passing into blue and green, also into yellow, brown, and black; transparent to opaque; hardness above that of quartz; specific gravity, 3.5. The red varieties of spinelle are called by jewellers *spinelle ruby*, while those possessed of a darker colour are called *Ceylonite* or *Pleonast*. The following analysis—the first of which is by Berzelius, the second by Klaproth, and the third by Descotils—exhibit the chemical composition of the species:—

	1. Blue Spinelle.	2. Spinelle Ruby.	3. Pleonast.
Alumina, .....	72.25	74.50	68.00
Silica, .....	5.45	15.50	2.00
Magnesia, .....	14.63	8.25	12.00
Oxide of iron, ...	4.26	1.50	16.00
Lime, .....	0.00	0.75	0.00
	98.59	100.50	98.00

The red varieties, exposed to the heat of the blow-pipe, become black and opaque; on cooling they appear first green, then almost colourless, and at last re-assume their red colour. They are with difficulty fused with the aid of borax—melting, however, a little more easily with microcosmic salt. Pleonast yields a deep green colour to the globule. The original depositories of this species are white limestone and a drusy volcanic rock. It is often found, however, in more recent deposits, formed by diluvial or alluvial action, along with crystals of corundum and zircon. The isolated crystals chiefly come from Ceylon. In Südermannland, in Sweden, bluish and pearl-gray varieties occur, imbedded in granular limestone. Crystals of a green colour are found imbedded in the drusy cavities of rocks ejected by Vesuvius. But the United States surpass the rest of the world, both as to the number of the localities of spinelle and the dimensions of its crystals. It abounds particularly in the townships of Amity and Edenville, in Orange county, New York; at which places it occurs in a highly crystalline white limestone, and likewise loose in the soil, in crystals varying from the size of a pea and under to those whose smallest diameter is 4 inches. Their colours are either black, or dark greenish, or bluish-black, though it is rarely of a pale pink or reddish-brown. These crystals are associated with hornblende, mica, augite, idocrase, and scapolite. Spinelle of a rich green colour is also found in the county of Sussex, New Jersey. The crystals from this spot are highly modified in their figure, and are sometimes nearly transparent. Green and blue spinelle is also found in Massachusetts. Clear and finely-coloured red varieties of the present species are highly prized as ornamental stones in jewelry. They go generally by the name of *spinelle ruby* or *balas ruby*.

**SPINET**, a stringed instrument formerly much in use, but now superseded by the pianoforte. It was somewhat similar to the harpeichord, and like that consisted of a case, sounding-board, keys, jacks, and a bridge. The difference between the spinet and the harpsichord was, that the latter was larger, and contained two or three set of jacks (small oblong slips

of wood, with crow-quills attached for striking) and strings so disposed and tuned as to admit of a variety of stops, while the former had only one set of jacks and strings, and consequently only one stop.

**SPINIFEX**, a very hard and spiny grass covering large areas of dry and otherwise barren ground in many parts of Australia. It grows in tussocks or clumps close together, and thus forms a serious impediment to travellers whether on foot or horseback, horses being lamed by the wounds it inflicts. It is also called porcupine grass; and botanically its name is *Triodia irritans*.

**SPINNING**. When the fibres of cotton, wool, or flax are intended to be woven they are reduced to fine threads of uniform size by the well-known process of spinning. Previously to the middle of the eighteenth century this process was performed by hand with the aid of the common spinning-wheel. Locks of cotton or wool, previously carded, were attached to a rapidly-revolving spindle, driven by a large wheel, and were stretched or drawn out by the hand at the same time that they were twisted by the spindle, upon which they were afterwards wound. Flax, the fibres of which are longer and more parallel, was loosely wound upon a distaff, from which the fibres were selected and drawn out by the thumb and finger, and at the same time were twisted by flyers, and wound upon a bobbin, which revolved with a velocity somewhat less than that of the flyers. The manufacture of textile stuffs by means of machinery, operating on a large scale, is an invention of the eighteenth century. Although of modern date, it has given birth to some of the most elaborate and wonderful combinations of mechanism, and it constitutes, especially in Britain, an important source of national wealth and prosperity. See articles COTTON-SPINNING, LINEN, and WOOLLENS.

**SPINOLA**, AMBROSIO, MARQUIS OF, one of the most distinguished generals of his age, was born at Genoa in 1569. He belonged to the most ancient of the four leading noble families of Genoa. From Guido di Spinola, who was consul in 1102, his ancestors filled the highest posts in the republic. Along with the family of Doria, they were the chiefs of the Ghibelline party in Genoa. His brother Frederick, who had been appointed to the command of the Spanish fleet on the coast of the Netherlands, induced him, in 1602, to join the Spanish forces in the Low Countries, with 9000 Italian and Spanish veterans whom he raised, equipped, and maintained at his own cost. This circumstance, at a time when the conduct of wars depended so much upon the troops being paid regularly, and the best concerted expeditions failed for want of money, assured him of the success which soon rendered him so celebrated. While mutiny and insubordination prevailed in the rest of the army his 9000 Walloons were models of discipline and order. The Archduke Albert of Austria, who was at this time governor of the Netherlands, employed Spinola in the capture of Ostend, which had been so long besieged by the Spanish troops that Albert despaired of reducing it. Spinola was more successful: it fell into his hands in September, 1604, after having sustained a siege of three years and two months. He obtained possession of a mere heap of ruins, but his reputation was at once spread over all Europe, in which every eye was fixed upon this siege. Spinola hastened to Madrid, to give the feeble king (Philip III.) information of the discontent and insubordination that were rife among the greater part of the troops in the Netherlands, and he received full powers to suppress their disorders. He was named commander-in-chief of all the Spanish and Italian forces in the Netherlands. On returning to the theatre of war he found Maurice

of Nassau opposed to him, and in him he met a more formidable opponent than he had hitherto encountered. The two generals ably availed themselves of the fortresses and nature of the ground to keep each other in check. A decisive naval action near Gibraltar, in which the whole Spanish fleet was destroyed by the Dutch admiral Heemskerck (1607), induced the Spanish court to propose an armistice, which was concluded between Spinola and Maurice for twelve years (1609). After the conclusion of the war Spinola still retained the command of the troops in the Netherlands. Occasionally he visited his native city, which showered honours upon him. Spinola was next actively engaged during the Thirty Years' war. In 1620 he conquered the Lower Palatinate, which had fallen into the hands of the Protestant league. In 1621, the truce with Holland having been allowed to terminate, contrary to the advice of Spinola, a new scene of action was found for that general in the Duchy of Juliers-Berg-Clèves, in the dispute regarding the succession to which Holland had interfered. In the year mentioned he took Juliers, after which he invaded Holland itself, and laid siege to Bergen-op-Zoom; but while besieging this place he found himself unexpectedly attacked at once by Mansfeld and Maurice, and was obliged to raise the siege. His retreat was, however, conducted in so masterly a manner that he did not leave behind one of his sick or wounded, or lose a single piece of ordnance. In 1624 he invested Breda, the gates of which were opened to him after a ten months' siege (May, 1625). This was his last achievement; his health obliged him to resign the command, although he once more appeared in the field, in Italy, in the war of the Mantuan Succession. He invested Casale, but was hampered in all his proceedings by the jealousy of the imperial general with whom he was obliged to act; and his death, which took place at Castelnuovo on the 25th of September, 1630, was hastened by the chagrin which he felt at this conduct, and by grief at seeing his country overrun by foreigners. Spinola was not only a great general, but also a consummate diplomatist. He was humane and disinterested, and his private life was adorned by virtues even rarer than these.

SPINOZA, BARUCH, or as he translated his name, BENEDICT, was born at Amsterdam on the 24th of November, 1632, of a family of Portuguese Jews, and early gave proof of a reflecting mind and an independent spirit. His first training he owed to the Talmudist Morteira, and he afterwards learned Latin and Greek from Van den Ende, a Dutch physician, with whose daughter Spinoza fell in love. Spinoza often avowed afterwards that he wished to marry her; but a rival succeeded in winning her affections, and he himself remained unmarried. From the study of the ancient languages Spinoza proceeded to that of theology, to which he gave himself up for several years. About this time the works of Descartes fell into his hands. He read them with avidity; and the Cartesian maxim 'that one should receive nothing as true that was not established by good and solid reasons' corresponded so entirely to the instincts of his inquiring spirit that he determined to adopt it as a guiding maxim for himself, and to submit to a strict examination all the opinions that had been instilled into him from his infancy. The goodness of his disposition could not preserve him from persecution when his mode of thinking was discovered. He was calumniated and accused before the synagogue. He refuted the accusations with calmness, in spite of menaces on one hand and zealous attempts to convert him on the other, but was at length excommunicated on the 6th of August, 1656. Before this he had quitted Amsterdam, having found

that even his life was endangered in that city. He retired first to the country-house of a friend, and then, in the summer of 1661, removed to Rhynsburg, near Leyden. In the spring of 1664 he transferred his residence to Voorburg, near The Hague, and finally, in 1669, settled at The Hague itself, where he remained till his death. Having been required, in accordance with the prescriptions of the Talmud, to learn a handicraft in his youth, he had acquired the art of grinding optical glasses; and it was by practising this art that he supported himself. He died on the 21st of February, 1677. Spinoza was all his life of very delicate health. He was afflicted from infancy with a disease of the chest, and it was to this that he ultimately succumbed. In his habits he was very abstemious and regular; in the intercourse of life he was kind and gentle, always affable and equable. Sometimes he would remain for months together confined to his house totally absorbed in his studies, finding his chief recreation in smoking, or in observing the contests of flies with spiders. His disinterestedness appears from the circumstance that he refused a gift of 2000 florins and the offer of a valuable legacy from his friend Van Vries, representing to his friend that he should leave his property to his brother. Afterwards he accepted an annuity from a friend, according to some accounts from the same friend. To his avaricious sisters he gave up all his patrimony, which was legally adjudged to him, retaining only a bed, that he might assert his right. Other incidents in his life bear striking testimony to his single-minded devotion to truth. When the Prince of Condé took possession of the government of Utrecht in 1678 he wrote to Spinoza, desiring to see him and offering to obtain for him a pension from Louis XIV., if he would dedicate one of his works to the king. But this offer Spinoza refused with politeness, yet with a certain degree of quiet contempt, afterwards observing to a friend that he had no intention of dedicating one of his books to Louis. In the same year he received an invitation from the elector palatine to accept the chair of philosophy at Heidelberg, with liberty to lecture as he should see fit, provided that he should say nothing to the prejudice of the established religion. But this he also declined on the ground that he did not know how far this liberty might extend, and did not wish to give offence to any one. Besides Spinoza's own works and letters, the principal authority for the events of his life is the biography by Colerus, a Lutheran divine (Dutch, 1698; English and French, 1706; German, 1733). The only two works of Spinoza that were published during his lifetime are *Renati Cartesii principia philosophiæ* (1663), to which the *Cogitata metaphysica* forms an appendix; and *Tractatus theologico-politicus* (1670; English translation, Lond. 1863), in which he subjects the idea of a revelation, and the questions of the origin and authenticity of the books of the Old Testament, to a severe criticism, and endeavours to show not only that freedom of thought can exist without endangering the public peace and virtue, but that it must necessarily stand or fall with them. His other works were published posthumously in the year of his death (1677) under the title B. d. S. [Benedicti de Spinoza] opera posthuma, with a preface written in Dutch by Jarrig Jellie, and translated into Latin by Ludwig Meyer. They include, besides a Hebrew grammar, his chief philosophical work, entitled *Ethica ordine geometrico demonstrata*; *Tractatus politicus*; *Tractatus de intellectus emendatione* (the last two unfinished), and a number of very interesting letters. All his works were published in Latin, although his *Ethica* was originally written in Dutch. His complete works have been edited by Paulus (Jena, two vols., 1802-1803), Gröner (Stuttgart, 1830), Bruder

(Leipzig, three vols., 1843-46), and Van Vloten and Land (2nd. ed., Hague, 1895). Newly-discovered writings of Spinoza were given to the world by Böhmer (Halle, 1852) and Van Vloten (Amsterdam, 1862). The principal of these discoveries is entitled *Tractatus de Deo et homine*, and is of great interest from the light that it throws on the development of Spinoza's views. There is an English translation of Spinoza's chief works by R. H. M. Elwes (two vols., 1884), and one of the *Ethics*, by W. H. White (1883). Berthold Auerbach published a German translation in five vols. in 1841. A French translation by Em. Saisset appeared at Paris in two vols. in 1842 (new edition, three vols., 1861).

The *Ethics* (*Ethica*) of Spinoza is the work in which his views are most completely and systematically developed. It was composed between 1662 and 1665, but appears to have been subjected by the author to constant revision till the time of his death. It is divided into five books, the first of which contains Spinoza's ontological system, or fundamental scheme of being; the second treats of the nature of the human mind; the third of the emotions and passions; the fourth of human servitude, that is, of the powerlessness of man to direct and restrain his passions; and the fifth of the influence of reason or of adequate ideas on the blind energy of the passions. One of the most astonishing features of this work of Spinoza's is its plan. In accordance with the profession of the title of the work, the ethical (or rather philosophical) views of the author are demonstrated, in form at least, after the method of geometry (*more geometrico demonstrata*); that is, Spinoza attempts to build up a system of philosophy, as Euclid had constructed a system of geometry, by a firm chain of reasoning depending on definitions and axioms. In Spinoza's system there are eight definitions and seven axioms. The definitions are:—

1. By cause of itself I understand that whose essence involves its existence, or that whose nature cannot be conceived unless existing.

2. That thing is called finite in its own nature which can be bounded by another of the same nature.

3. By substance I understand that which is in itself, and is conceived through itself; that is, that whose conception does not require the conception of another thing by which it must be formed.

4. By attribute I understand that which the understanding perceives of the substance as constituting its essence.

5. By mode I understand the accidents of substance, or that which is in something else, through which likewise it is conceived.

6. By God I understand a being absolutely infinite, that is, a substance consisting of infinite attributes, every one of which expresses an eternal and infinite essence.

7. That thing is called free which exists from the mere necessity of its nature, and is determined to act solely by itself; that thing, on the other hand, is called necessary, or rather constrained (*necessaria vel potius coacta*), which is determined to exist by something else, and to act by fixed and determinate causes (*certa ac determinata ratione*).

8. By eternity I understand existence itself, in so far as it is conceived to follow necessarily from the mere definition of an eternal thing.

The axioms are:—

1. Everything that exists, exists either in itself or in something else.

2. That which cannot be conceived through something else must be conceived through itself.

3. From a given determinate cause the effect necessarily follows; and reversely, if there be no given determinate cause it is impossible for the effect to follow.

4. The knowledge of the effect depends on the knowledge of the cause and involves the same.

5. Things that have nothing in common with one another are likewise incapable of being understood by means of one another, or the conception of one does not involve the conception of the other.

6. A true idea must correspond with that of which it is the idea.

7. Whatever can be conceived as not existing does not involve existence in its essence.

Having stated his definitions and axioms Spinoza proceeds to demonstrate his propositions. The first part of his argumentation culminates in the demonstration of the existence of God as the sole substance. It follows from the very definition of substance that it must be infinite, otherwise it would be limited by something else, without which, therefore, it could not be conceived. Being infinite this single substance must possess an infinity of attributes, each infinite in its own nature. Yet for the human understanding there are only two attributes of the divine substance, extension and thought. That, however, is because the human understanding is unable to discern any more, not because they are the only two that belong to the substance. All individual existences, that is, all ideas and material things, are merely modes or accidents of the divine substance, and they are in the one case ideas because they appear to us under the attribute of thought, and in the other case material things because they appear under the attribute of extension. God is the immanent, not the transient cause of all that is and happens, that is, not a cause acting in producing something different from itself, but merely in manifesting itself in a particular way. The world is the self-representation of the divine substance, and cannot be other than what it is. Finite things are determinate modifications of the attributes of God, material things of the attribute of extension, minds of the attribute of thought. Between the modifications of the two attributes there is no causal connection, but a complete parallelism founded on the fact that they are attributes of the same substance. Every finite thing may be regarded in two ways, first as it is contained in other modifications of the same attribute, and secondly as a modification of the infinite substance itself. The first mode of knowing finite things is inadequate; the second, which apprehends things under a certain appearance of eternity, is adequate, and the true philosophic mode of apprehension, always seeing the infinite itself in all its manifold forms. The mind knows itself as the sum of these modifications of the thinking substance which correspond to the changes in a mode of the extended substance, that is, the human body.

The above may be taken as a summary of the first two parts of the *Ethics*. The third part, which treats of the emotions and passions separately, is of great psychological value, but cannot be shortly summarized. In the fourth part of the *Ethics* Spinoza shows that man is completely subject to his passions. In accordance with his fundamental position that God is the immanent cause of everything that happens, Spinoza denies to man free-will. God himself is free, inasmuch as he acts only according to the laws of his own nature. Man, however, is subject to necessity. Every one strives of necessity to obtain that which is useful to him. That which really answers to this endeavour is good, and that which thwarts it is bad. But what is good and bad in this sense for one man is good and bad for all men, therefore those who know what is really good and bad, or, in other words, those who are guided by reason, are true, just, and honourable. In the fifth part of the *Ethics*, as we have already had occasion to state, Spinoza explains the influence of reason on the passions. When he

allows that a man may be guided by reason he does not contradict his other position that man is wholly subject to his passions. Reason, he says, can control certain passions only because it is connected with other passions or emotions, which are stronger than the rest. Those emotions are joy and love. Wherever reason possesses a man, or what is the same thing, whenever a man has a clear and distinct knowledge of his passions, that man rejoices in his knowledge, and his joy is accompanied by an idea of God, since all clear knowledge, according to Spinoza, involves an idea of God. Now joy, accompanied by the idea of its cause, is love (this is one of the theses of the third part), and love to God is an emotion which from its very nature must fill the mind in a pre-eminent degree, and be superior to all other emotions.

See Jacobi's work, *Ueber die Lehre des Spinoza in Briefen an Mendelssohn* (1786); Sigwart, *Der Spinozismus historisch und philosophisch erläutert* (1839); Cousin's *Fragmente de Philosophie Moderne* and *Histoire Générale de la Philosophie*; *Refutation inédite de Spinoza*, by Leibnitz (1854); Jouffroy's *Cours de Droit Naturel* (lectures VI. and VII.); Willis's *Benedict de Spinoza*; his *Life, Correspondence, and Ethics* (1870); Matthew Arnold's *Essays in Criticism*; the arts. *Cartesianism* and *Spinoza* in the *Ency. Brit.*; Pollock's *Spinoza's Life and Philosophy*; Martineau's *Study of Spinoza*; J. Caird's *Spinoza*; Hoff's *Die Staatslehre Spinoza's* (1895); and the histories of philosophy.

**SPIRACLE**, the name given to the apertures existing on the sides of the body in Insects, Centipedes, Spiders, &c., and through which air is admitted to the breathing organs which consist of air-tubes. The name *stigmata* is also given to these apertures, and to the breathing apertures existing in the bodies of such lower Annulose forms as Leeches, Worms, &c. The spiracles of insects are the most typical in form, and may present very great differences in shape and size. As commonly seen, each spiracle presents the form of a rounded or oval opening, the margin of which is formed by a horny ring. The opening itself may be closed by a kind of grating, and may be surrounded by delicate bristles or hairs—the obvious use of these appendages being to exclude extraneous or solid matters from the breathing apparatus. The spiracles also appear capable of being closed at the will of the insect; and the use of this power is apparent when we consider that in the rapid flight of insects the open condition of these apertures would undoubtedly impede the free movements of the animal by the entrance of currents of air. In insect-larvæ each segment of the body is usually provided with a pair of spiracles; and in aquatic larvæ, which breathe air directly from the atmosphere, one of the hindmost spiracles of the body is generally prolonged into a tube, the mouth of this tube remaining above the surface of the water, and air being thus supplied to the breathing organs independently of the immersion of the body.

**SPIRÆA**, a genus of herbaceous or half-shrubby plants, belonging to the natural order Rosaceæ and the sub-order Spirææ. They are natives of the temperate countries of the northern hemisphere. Of the sixty or seventy species belonging to this genus several are cultivated as ornamental plants. The flowers are white and rose-coloured. The *Spiræa ulmaria*, commonly called Queen of the Meadow or Meadow Sweet, is a large and beautiful herbaceous plant common in Britain. It grows to the height of about 3 feet, and has smooth, pinnate leaves, with unequal leaflets, often covered underneath with a white down. The flowers are small and numerous, arranged in cymes, white in colour, and sweet smelling. The *Spiræa filipendula*, or Dropwort, is also a native

of Britain. It has somewhat tortuous branches, pinnate leaves, with from seventeen to twenty-one leaflets, and also has numerous small white flowers arranged in cymes. In Sweden its tubers are used to make bread. The *Spiræa lobata*, or Canadian Queen of the Meadow, is a fine plant, with running, vivacious, fragrant roots, and producing equally fragrant flowers of a rose colour.

**SPIRAL**, a curve whose curvature varies continuously according to a continuous and uniform law (see LOGARITHMIC CURVE). According to the above definition a so-called spiral staircase is not spiral, nor is the thread of a screw; such curves are helices. The definition will include helices which either increase or diminish in pitch continuously. A plane spiral resembles the balance spring of a watch; a helix is represented by the thread of a screw. The name spiral is sometimes given to a helix. In common language spiral appears to have a generic value, while helix is specific.

**SPIRE**, 'a steeple diminishing as it ascends, either pyramidally or conically' (Gwilt). The pyramidal form is by far the most common. The spire is a feature of Gothic architecture, but it cannot be said in which of the countries where the Gothic architecture prevailed the feature originated. A spire always rises from a tower, and was originally nothing else than a wooden roof for the tower which it surmounted. A *broach* spire is one that springs immediately from the cornice of the tower. In early specimens this is the most common form, but at a later period the spire is usually made to rise within the cornice of the tower, the angles of which are frequently surmounted by pinnacles to break the transition between the straight and the tapering parts. The earliest examples of spires in England, if not the earliest anywhere, are of Norman date (twelfth century). In France spires are first found in common use in the province of Anjou. But they were not confined to that province even in the earliest period of their use. One of the most ancient specimens adorns the cathedral of Chartres, the southern spire of which was probably completed in the twelfth century. In Germany the oldest specimens are found in Westphalia. That of an old church at Soest probably dates from about the year 1200. A peculiar feature of some of the German spires is their profusion of open work, such as is seen in the spires of Freiburg and Strasburg. There are two open work spires by German artists on the cathedral of Burgos in Spain, and there are other examples of the same style in Spain and Portugal, which makes it doubtful whether the style is not indigenous to the Peninsula. As a general rule the spires of continental cathedrals have a larger angle than those in England, the angle being in the former case about one-sixth of a right angle and in England one-ninth. In the spire of Chichester Cathedral the angle is 13°, or about one-seventh of a right angle, which has a very fine effect. Some spires of very great height have recently been erected, the highest being that of Ulm Cathedral, 580 feet, and the two of Cologne Cathedral, 520 feet. Next to these come St. Nicholas, Hamburg, 478; Strasburg Cathedral, 468; Rouen Cathedral (cast-iron open work), 465; and St. Stephen's, Vienna, 441 feet. The highest spire in England is that of Salisbury Cathedral, 404 feet.

**SPIRES** (German, *Speyer* or *Speier*), a town in Bavaria, capital of the government Pfalz (Palatinate), on the left bank of the Rhine, where it receives the Speierbach, 10 miles s.s.w. of Mannheim. In early times Spires was a fortified outpost of the Romans, intended to guard against the attacks of the Alemanni. In more modern times, especially under and after Charlemagne, it was long the residence of the emperors

of Germany and the seat of the Germanic Diet. The imperial chamber, or Reichskammergericht, the supreme appeal court of Germany, had its seat here for 200 years. The prosperity of Spire began to decline in the seventeenth century, and it has never quite recovered from the blow inflicted by Louis XIV. in 1689, when he caused it to be burned down. It came into the possession of Bavaria in 1816, and much has since been done for its improvement. The most imposing edifice is the cathedral, begun by Conrad II. in 1030 and completed under Henry IV. in 1061. It has suffered greatly by fire once or twice, and after immense damage inflicted by the French in 1794 it was re-consecrated in 1822. Since then it has received various additions, and has been adorned with statues and frescoes. A considerable portion of the original structure appears still to remain, the building being a vaulted basilica with an eastern transept and a western porch or narthex, two domes, and four towers. Eight German emperors were buried in it. Besides the cathedral the town contains two other Roman Catholic churches, three Protestant churches, among them the new church built in commemoration of the famous protest, a synagogue, and a former Jesuit college, now occupied by the chapter of the cathedral. The only relic of the former fortifications of the town is an old gate tower, the Altpörtel. Among other objects of interest are the remains of the walls of the old Retscher pulace, the scanty ruins of the fifteenth-century cloister, the new consistorial building, the gymnasium, a real-school with an excellent museum of German antiquities, a Roman Catholic seminary, a Roman Catholic institution for training teachers, a hospital, an orphanage, &c. The industries include cotton-spinning, iron and brass founding, brewing, and the manufacture of tobacco, cigars, machinery, boots and shoes, &c. Of the numerous diets held at Spire the most memorable is that of 1529, when the Reformers gave in the famous protest which originally conferred upon them the name of Protestants. Pop. (1895), 19,044; (1900), 20,911.

**SPIRIT**, a name applied, in ordinary language, to *spirit of wine* or ethylic alcohol, and *wood spirit* or methylic alcohol, while alcoholic liquors are also called *spirits*. (See ALCOHOL, WOOD SPIRIT.) In pharmacy the name spirit is still applied to aromatic alcoholic distillates and certain alcoholic solutions. The name was formerly applied to a great many liquids supposed to contain essential principles as they were termed.

**SPIRITUALISM**, a system of professed intercourse with the spirits of the departed. The believers in the system are called spiritualists, and maintain that in the first place there is no *a priori* reason to show why spirits should not manifest themselves, and secondly that there is a superabundance of specific evidence, such as would be admitted in other important cases in a court of law to be decisive, proving that they actually do make manifestations. The modern form of spiritualism, which originated in America in 1848, has much in common with the doctrines of Mesmer and other German spiritualists of the eighteenth century. The doctrine of clairvoyance, so closely associated with mesmerism, may be regarded as having led the way to the modern spiritualism. The celebrated phenomenon of 'spirit-rapping' was first manifested, it is said, to a family of the name of Fox, of Hydeville, New York. Mysterious raps were heard about the house, and soon a system of communication was established with the invisible rapper, who answered various questions put, and announced the presence of a spirit. The neighbours were soon invited to put questions through the medium of one of the

members of the family. These alleged manifestations first became notorious throughout a wider circle by the professed discovery of a long-concealed murder through the rapping of the spirit of the murdered man. After this the excitement and curiosity of the neighbourhood became extreme, and the Fox family were made the subject of endless questions and investigations, the Fox girls having appeared in public, and the so-called spirit phenomena being subjected to various tests. Spirit-rapping, table-turning, and the other phenomena of spiritualism soon became much more general, and already in 1852 there were in Philadelphia alone 300 spiritualist circles, there being about 30,000 mediums, or persons whose organization fitted them for communicating with the spirit-world, in the United States. More remarkable phenomena than any hitherto manifested were produced through the mediumship of D. D. Home (a native of Scotland), who in 1850, at the age of seventeen, became publicly known in America as a medium. One of the phenomena said to be now exhibited was that of 'levitation', the medium being raised from the ground by spiritual agency. In 1855 he went to Europe, and gave séances before Napoleon III., and Alexander II. of Russia. Besides spirit-rapping and table-turning the most remarkable of the spirit manifestations are spirit drawing and writing, spirit-photography, the lifting and moving of heavy bodies by spiritual means, the floating of persons in the air, and spiritual musical performances. In some cases the writing and drawing are done by the hands of mediums, but, it is asserted, in such a manner as quite exceeds the natural powers of the mediums; in other cases they are professedly done by direct spiritual agency without the intervention of human instrumentality. The introducer of spiritualism into England was Mrs. Hayden, who came from America to England in 1852; and for some time all the mediums that appeared in England were Americans or people who had settled there. She was followed in 1855 by the celebrated Home, in 1859 by Squire, and afterwards by others. Spiritualism has now spread over the whole civilized world, and numbers its believers by millions, its headquarters being still in the United States. Many men of considerable eminence have become converts, among whom we may mention Dr. A. R. Wallace, Sir Wm. Crookes, and Prof. De Morgan. The Incorporated Society for Psychical Research was formed in 1882 to investigate mesmeric, spiritualistic, and similar phenomena. The following works may be referred to:—Owen, *Footfalls on the Boundary of Another World* (London, 1860); The *Debatable Land between this World and the Next* (London, 1870); D. D. Home, *Lights and Shadows of Spiritualism* (1877); Hare, *Experimental Investigation of the Spirit Manifestations Demonstrating the Existence of Spirits* (New York, 1858); Home, *Incidents in my Life* (London, 1863–1872); De Morgan, *From Matter to Spirit* (London, 1863); Wallace, *Miracles and Modern Spiritualism* (London, 1875); *Phantasms of the Living*, by Gurney, Myers, and Podmore (two vols., 1887); W. B. Carpenter's *Mesmerism, Spiritualism, &c.* (1877); W. Crookes's *Researches* (1874). See also *Proceedings of the Psychical Research Society*.

**SPIRULA**, a very interesting genus of Dibranchiate or two-gilled Cuttle-fishes (Cephalopoda), belonging to the family Spirulidae, which is distinguished by the possession of an internal chambered shell of nacreous structure and discoidal form, the whorls of the shell being separate, and a *sipuncle* (which see) or tube piercing the septa or partitions of the shell on their ventral surfaces. *S. Peronii* is

a species which inhabits the Pacific Ocean. See also CEPHALOPODA and MOLLUSCA.

**SPITALFIELDS**, a parish in London, included in the borough of Tower Hamlets. It early became celebrated for its silk manufactures, which were established by French refugees after the revocation of the Edict of Nantes, but this industry is now declining. Brewing is largely carried on. It takes its name from the hospital of St. Mary founded here at the end of the twelfth century. Pop. of sub-district (1891), 26,594; (1901), 27,965.

**SPITHEAD**, the roadstead frequented by ships of war at the entrance of Portsmouth harbour. It extends about 2 miles N.W. and S.E. along the S.W. side of the Spit Sand, with an average width of  $1\frac{1}{2}$  mile between that shoal and the No Man and Sturbridge Shoals on the Isle of Wight shore. The depth of water varies from 4 to 16 fathoms. The system of fortifications intended for the defence of Portsmouth harbour and dockyards is also designed as a protection for the roadstead of Spithead. See PORTSMOUTH.

**SPITZBERGEN**, a group of islands in the Arctic Ocean, between Barents Sea on the east and Greenland Sea on the west, 400 miles north-north-west of the North Cape in Norway. They lie between the parallels  $76^{\circ} 30'$  and  $80^{\circ} 30' N.$ , and are about half-way between Greenland and Nova Zembla. The archipelago comprises six large islands and a large number of smaller ones. The largest island is West Spitzbergen, which has a triangular form with the apex pointing south. Its coast is indented by many fiords, of which the two largest are Ice Fiord on the west coast, running north and north-east, and Wijde Bay, penetrating southwards from the north coast. The northern branch of Ice Fiord almost meets the head of Wijde Bay. The narrow Foreland Sound separates the smaller island of Prince Charles Foreland from part of the west coast of West Spitzbergen, and to the north-east, separated from the main island by Hinlopen Strait, lies the second largest island, North-East Land. Of the smaller islands we may mention Danes Island, off the north-west coast of West Spitzbergen, notable as the place from which Andr  e set out on his balloon voyage to the North Pole. The total area of the Archipelago is about 27,000 square miles, of which West Spitzbergen represents about 15,000. West Spitzbergen is in the main covered with great accumulations of ice, except along the west shore of Wijde Bay, where there is a relatively fertile area. The middle of the island, west of the main watershed, is described by Sir W. M. Conway as a region of boggy valleys, fertile slopes, and mountain ridges, or the remains of a high plateau. The highest measured peak of the island is Horn Sound Tind in the south, fully 4500 feet above sea-level. Large glaciers are found throughout the whole group, but especially on the eastern coasts. Geologically the backbone of the island consists of granite, with gneiss and other archaic rocks, but Carboniferous, Triassic, Jurassic, Miocene, and even more recent formations are also well represented. During Miocene times Spitzbergen had a luxuriant flora, and there was also a post-glacial period of genial climate favourable to the development of a varied phanerogamic flora. The proximity of the Gulf Stream renders the climate, especially on the west coasts, less severe than that of other places in the same latitude. For four months in winter the sun is below the horizon, and for an equal period in summer always above it. The most characteristic plants of the archipelago are mosses and lichens. Rather more than one hundred species of phanerogams, however, have been collected on the islands. The grasses form nearly a quarter of

these, and next to them in number of species are the cruciferous plants. The larger forms of animal life are foxes, bears, and reindeer, in pursuit of which, as well as the walrus and seals abounding along the coasts, the islands are frequently visited by the Norwegians and Russians. Sea-fowl are so numerous that they literally hide the rocks and darken the air. The minerals include beautiful marble and good coal. The group is sometimes said to have been first discovered (1553) by Willoughby, but the islands were known to the Russians before that time. They were again discovered in 1596 by the Dutch navigator Barents. To the latter navigator the islands owe their name (in Dutch spelling Spitsbergen), signifying 'peaked mountains'. The coasts of the chief islands have been explored by many expeditions since that time, and during the nineteenth century the islands were used as a base for expeditions towards the North Pole. The interior was hardly known till the recent explorations (1896-97) of Sir W. Martin Conway, who was the first to cross West Spitzbergen from west to east. There are no settled inhabitants, but explorers and others have often passed one or more winters in the archipelago. In the days of the Spitzbergen whale fishery there was a thriving Dutch village called Smeerenberg on a small island to the north-west of West Spitzbergen. Tourist steamers make regular sailings to Spitzbergen during the summer months from Hammerfest and Hamburg. A tourist hotel was built in 1896 at the entrance to Advent Bay, a branch of Ice Fiord.

**SPL  EN**, an abdominal gland which, in man at any rate, is now generally regarded by physiologists as forming one of the *ductless* or *blood glands*, and which is accordingly classed with the thyroid gland, thymus, and supra-renal capsules (see those articles). All Vertebrates—with the exception of the Lancelet, and probably the Lampreys, Lepidosirens (or Mud-fishes), and the Ceratodus or Barramunda—possess a spleen, which is thus seen to be absent from the sub-kingdom in certain aberrant fishes only. In man the spleen lies in the upper part of the abdomen, and is situated in the left hypochondriac region, contiguous to the cardiac or gullet end of the stomach. Its outer surface is smooth, and lies in contact with the under surface of the *diaphragm* or *midriff*, this latter muscle separating the spleen from the ninth, tenth, and eleventh ribs of the left side. Externally the spleen is covered by the *peritoneum*, and is connected with the stomach by the omentum (which see), known as the *gastro-splenic band*. Its internal aspect is concave, and is divided by a longitudinal groove or fissure named the *hilum*. This fissure divides its surface into an anterior and posterior portion, the former being the larger. The blood-vessels and nerves of the spleen enter and leave the organ by the hilum. Inferiorly the internal surface of the spleen is in contact with the pancreas or 'sweet-bread', and posteriorly with the supra-renal capsule of the left kidney. The upper end is of rounded conformation, and is thick; whilst the lower extremity is pointed, and is in contact with the *colon* (see *INTESTINE*). A *suspensory ligament* or special fold of peritoneum attaches the spleen to the under surface of the midriff. The size of the spleen appears to vary much even in healthy individuals, the size being probably determined by individual peculiarities in the circulation. Its average size in the healthy human adult is about 5 inches in length, by 3 or 4 inches broad, and 1 inch or  $1\frac{1}{2}$  inch in thickness. Its average weight is 7 ozs. In the adult the spleen weighs, in proportion to the entire body, as 1 to 320, or as 1 to 400. In the infant its weight, as compared with that of the body, is as 1 to 360. In old age the

spleen loses bulk and weight, the proportion at the latter period of life being as 1 to 700. Physiologically viewed the organ also appears to increase in size during the process of absorption, occurring after the digestion of food. It is large in well-fed animals and small in starved animals. In some diseases—such as ague, &c.—it may increase to 18 lbs. or 20 lbs. in weight. Regarding the structure of the spleen, the organ is found to be invested by an outer membrane of serous kind (see MEMBRANE), which is formed by the peritoneal layers, and is of thin, smooth texture. It covers the entire surface. Below the serous coat a second investment of fibrous nature is found. This latter is of elastic structure, and forms the framework or supporting fibres of the internal structure, by sending processes or *trabeculae* from its inner surface into the anterior. These trabeculae branch and ramify within the spleen so as to form a veritable meshwork, supporting the essential and softer tissues of the organ, and to this meshwork the general name of the *stroma* is given; whilst the essential spleen matter which it supports receives the name of *spleen pulp*. This latter substance, which occupies the interstices of the trabeculae, is of a dark brownish-red colour, and when microscopically viewed is seen to be composed of coloured parts, consisting of red blood corpuscles and other cells of coloured nature; whilst other bodies of deep-red, yellow, or black hue, existing singly or aggregated together, may be seen amid the spleen pulp. All these substances, when chemically examined, bear a distinct relation to the hæmatin, or colouring-matter of the blood. The colourless elements seen in the spleen-structure are granular matters, free nuclei (which see) of cells, as well as nucleated cells or vesicles. The colourless elements form about two-thirds of the pulp of the organ, and are of the same nature as the round white cells of lymphatic glands, being called lymphatic elements. They are also similar to white blood-corpuscles. When the spleen is cut through, as in a vertical section of the organ, a number of opaque bodies of small size, masses of round cells, are seen to be scattered throughout its substance. They are of smaller size in man than in most other mammals, and are seen more typically in early than in adult life. To these bodies the name of the *Malpighian* or *Splenic corpuscles* is given. When their more intimate relationship to their surroundings is investigated they are seen to be attached to the sheaths of the small arteries or blood-vessels of the spleen, and are in fact outgrowths from, or buds of these arterial sheaths. They are coloured grayish-white, and consist each of a capsule of fibrous matter, the fibres of which form a fine network-like structure. On the surface of the capsule minute blood-vessels also ramify, these latter being branches of the vessel to which the corpuscle is attached; and the Malpighian bodies have also very intimate relations with the veins. Each Malpighian body is in fact composed of a mass of corpuscles resembling lymph-corpuscles (see LYMPH) in form. Under starvation (which see) these bodies decrease in size, or may disappear altogether, whilst after the digestion of albuminous matter in particular they may attain a great increase in size. The *splenic artery*, supplying the organ with blood, is of large calibre, and pursues a remarkably tortuous course within the spleen. It enters the organ at the *hilum*, and its branches carry with them into the interior sheaths, derived from the outer or fibrous coat of the organ. The ultimate branches, or finest capillaries of the artery, form capillary tufts, which are imbedded amid the spleen pulp and its elements already described, and the capillaries themselves terminate either in the veins of the organ, or in open spaces, termed *lacunae*, which in turn give origin to veins.

The veins of the spleen, like the splenic artery, are of large relative size, and they unite to form a large (*splenic*) vein, which pours its fluid into the *portal vein*. The nerves of the organ are derived from the right and left *semilunar ganglia*, and form the *right pneumogastric nerve*.

Bearing in mind the intimate relations of the Malpighian bodies and the blood-vessels of the spleen, we may next note the functional aspects of the organ. In the earlier days of physiological study the ductless nature of the organ formed a puzzle to investigators; and so futile were their hopes of discovering its functions that we find one ancient authority stating that its only duty was that of serving as *packing* or *stuffing* for the other abdominal organs, so as to keep the latter in their due places! Modern research has, however, shown that in all probability the spleen is the seat of the change and elaboration of the red blood corpuscles, which form so characteristic elements in vertebrate blood. It is thus to be regarded as a blood gland, or kind of lymphatic gland. That this idea is correct may be inferred from the fact of the organ becoming larger during the process of absorption, whilst at this period its albuminous matters increase in quantity, so that its office in one aspect is clearly that of storing up (for further elaboration) these necessary elements of the blood. In the blood of the splenic vein—which is returned to the venous circulation through the portal vein—an unusually large number of white blood corpuscles are seen, and in the peculiar disease named *leucocythæmia* (or 'white-celled blood'), which is characterized by the large and abnormal increase in the blood of white corpuscles, the spleen itself becomes enlarged. This fact might tend to show that in a disordered state of the organ the elements of the blood, otherwise elaborated, are sent into the system in an unaltered state. Thus the opinion of Kolliker, that the spleen is a manufactory of red blood corpuscles—which themselves are derived from the white corpuscles—is a very reasonable supposition; and from the spleen these corpuscular elements, elaborated in the first instance from the food itself, are sent forth into the general circulation to perform their functions in the nutrition of the organism. In the spleen also it is probable that the worn-out red corpuscles may be broken down and eliminated from the economy; the pulp of the organ, as already described, containing such elements in all stages of growth. These worn-out corpuscles are in all probability converted into the pigment or coloured materials seen in the spleen-pulp. It is also supposed that the spleen, from its intimate relationship to the portal circulation (which see), or that sent to the liver, acts as a reservoir for blood in cases in which the normal flow to the liver is obstructed. This view is rendered exceedingly feasible by the well-known fact that in congestions of the liver, for example, the spleen enlarges; whilst, when the congestion is relieved by the blood being discharged from the stomach or bowels, the enlargement of the spleen diminishes. It may lastly be noted that the spleen may be removed or extirpated both from man and lower animals without any bad consequences appearing to follow the operation. This latter result is explicable on the ground that other glands (thyroid, thymus, or even the ordinary lymphatics) may assume the functions of the absent spleen. Meyer, indeed, has found these glands enlarged by the removal of the spleen. The spleen in some mammals (as in *Ornithorhynchus*, which see) may attain a much larger size than in man, and may consist of two lobes, or of three lobes as in *Echidna*. Whilst in *Rodentia* an accessory spleen may be found, as also in the Sturgeon, Narwhal (which see), and Dolphin. Of the diseases to which

the spleen is liable inflammation and enlargement are the most common. Inflammation (*splenitis*) may result in splenic abscess and gangrene; whilst the organ may be affected by various forms of tubercular and syphilitic disease, and is liable to be ruptured by violence—as from a direct kick or blow. Enlargement (known popularly as *ague-spleen*) results from chronic ague or intermittent fever, and may sometimes be met with in pregnant women, and also in the disease *leucocythæmia*, already noticed.

**SPLICING**, joining two rope-ends together by interweaving the strands in a regular manner. There are several methods of splicing, according to the services for which it is intended; the long rolling splice is chiefly used in lead or log lines, &c., where the short splice would be liable to separation, as being frequently loosened by the water: the long splice occupies a great extent of rope, but by the three joinings being fixed at a distance from each other, the increase of bulk is divided; hence it resembles a continuous lay, and is adapted to run through the sheave-hole of a block. The short splice is used upon cables, slings, block-strops, and, in general, all ropes not intended to run through blocks. Spliced eye forms a sort of eye or circle at the end of a rope, and is generally used on the end of lashing block-strops, for splicing in thimbles, bulls'-eyes, &c. In machinery the term is used to signify the connecting of pieces of wood or metal, such as beams or railway-bars, by means of overlapping parts bolted together, or so shaped as to hold themselves in continuity.

**SPLINTER-NETTING**, formerly in ships a net formed of  $\frac{1}{2}$ -inch rope, lashed at every rectangular crossing, and spread from rigging to rigging between the main and mizen masts, to prevent wreck from aloft wounding the men at the upper deck guns during action.

**SPLUGEN**, a mountain of the Rhetian Alps, on the frontiers of Lombardy (Italy) and the Grisons (Switzerland), rising 9350 feet above sea-level. The pass through this mountain communicating with the two above-mentioned countries is very ancient, having been known to the Romans. Up till 1819 it was, however, traversed by a bridle path only. The modern road, which was completed in 1823 by the Austrian government, reaches an elevation of 6940 feet, descends along the Italian slope by numerous zigzags, and is protected from avalanches by three galleries (covered portions of the pass constructed of solid masonry), respectively 744, 682, and 1640 feet in length, the longest on any Alpine road. A French army under Marshal Macdonald traversed the old path, 27th November to 4th December, 1800, and lost severely in men and horses from the descent of avalanches.

**SPODUMENE** is a mineral found massive, in large cleavable individuals, whose primary form is an oblique rhombic prism of 93°. Its cleavage parallel with the lateral planes of this figure is easily effected; but its terminal cleavages are obscure; lustre pearly; colour various shades of grayish-green, passing into greenish-white; streak white; translucent; brittle; hardness nearly equal to that of quartz; specific gravity, 3.17. It consists of—

Silica, .....	66.40
Alumina, .....	23.30
Lithia, .....	8.85
Oxide of iron, .....	1.45
	—
	100.00

If exposed to a red heat it loses its transparency and colour. Before the blowpipe it exfoliates, intumesces, and then melts into a nearly colourless, transparent glass. It occurs in primitive rocks, usually associated with quartz and feldspar. It was first discovered

in Sweden, at Utö, afterwards at Sterzingen, in the Tyrol, and was considered a rare mineral, but subsequently became common, having been discovered in the greatest abundance in Massachusetts.

**SPOHR**, LOUIS, a distinguished composer, was the son of a physician in Brunswick, and born in 1784. He studied music, and at an early age had acquired a great reputation as a performer on the violin. About 1805 he was appointed conductor of the court concerts at Gotha, and became afterwards musical director of the Theater an der Wien, Vienna, for which he wrote some of his finest dramatic works. He became chapel-master to the electoral court of Hesse-Cassel in 1823, and continued in that office till near the end of his days. He died at Cassel on 22d October, 1859. Spohr is regarded as the first composer of the day of violin music, consisting of solos, concertos, and chamber-pieces, and his performance on that instrument was characterized by breadth and vigour of tone. He is also the author of *Faust*, *Jessonda*, *Zemire und Azor*, and other operas, which occupy a high rank among musical compositions. His oratorios, *The Last Judgment* (*Die letzten Dinge*), *The Fall of Babylon* (produced first at a Norwich musical festival), and *Calvary* (*Des Heilands letzte Stunden*) are grand and elaborate works. His music, however, is of too scientific and classical a nature to be popular, and being singularly deficient in melody, its technical excellence is only appreciable by persons thoroughly conversant with high musical art. His Violin-school (*Violinschule*) is one of the best and completest works on violin playing ever written.

**SPOIL FIVE**, a round game of cards played with the whole pack of fifty-two, and by any number of persons up to ten, but about five make the most interesting game; it is never played with partners. Under the Stuarts this game was fashionable in Britain, and was then called 'Maw;' in the Compleat Gamester of 1674 it is called Five Cards; and in Ireland, where it has long been, and still is, a favourite game, it is known as Spoil Five. One of the players takes the pack and deals a card round to each of the company in succession till a knave is thrown; the player to whom it falls becomes the dealer. The pack is cut by the person on the dealer's right and dealt from right to left in twos and threes, each player getting five cards. The card on the top of the pack determines trumps, and is placed face upwards on the pack. Each player pays to the pool a certain stake or number of counters as agreed on. At the close of a game the winner takes the pool, except when a *spoil* (explained below) occurs; in this case the stakes remain, and each player puts an additional sum (generally half the original stake) into the pool, and so on after every spoil until a game is won. Should the turn-up card be an ace, the dealer has the privilege of *robbing*, that is, of exchanging any card in his hand for the ace; the dealer must lay aside his card before the eldest hand plays; but the ace should not be taken in until it is the leader's turn to play. The player who holds the ace of trumps must rob, but is not bound to declare he is about to do so until it is his turn to play, when he must place the rejected card face downwards on the table. If he neglects to do this he loses the privilege of robbing, and cannot win the game that hand, though he may play his cards and try to spoil it. The player at the dealer's left leads, and the dealer himself is the last to play. The player of the highest spoil-five card (see order of the cards below) wins the trick. Trumps win other suits. The winner of the trick then leads, and so on, till the hand is played out, or until one player gains three tricks. When a trump is led the players must follow suit except in special cases men-

tioned below. When a plain suit is led any one may play trump to it, though able to follow suit; but a player holding no trump must follow suit if he can. A player who takes three tricks in one hand wins the game. If no one gains three tricks the game is spoiled, and it should be the effort of each player, if unable personally to gain three tricks, to prevent any other from doing so by playing to thwart the one most likely to succeed. The cards rank as follows: in *red suits not trumps*, the king (highest), queen, knave ten, nine and so on down to the ace, which is lowest. In *black suits not trumps*, king, queen, knave, ace, two, three, and so on, up to ten, which is lowest. The ace of hearts always ranks as a trump, consequently in the above-mentioned order for red suits not trumps the ace must be omitted from the heart suit. In *red suits when trumps the cards rank as follows*: five (highest) knave, ace of hearts, ace of diamonds (when diamonds are trumps), king, queen, ten, nine, eight, seven, six, four, three, two; in *black suit when trumps*; five, knave, ace of hearts, black ace, king, queen, two, three, four, six, seven, eight, nine, ten. The five of trumps, knave of trumps, and ace of hearts may *renege*, that is, the player holding them is not bound to follow suit when an inferior trump is led. The five may renege to any trump, but no trump can renege when the five is led. The knave may renege to any trump except the five, and if the knave is led no trump can renege except the five. So the ace of hearts may renege to any trumps except the five and knave; and if the ace of hearts is led only the five and knave of trumps can renege. Hearts need not be played to the ace of hearts led by players holding no trumps, as it is a trump, and the rule about following suit only applies to the ace of hearts in its capacity as a trump. See Cavendish, Pocket Guide to Spoil Five (De la Rue & Co., London).

**SPOLETO** (the ancient *Spoletium*), a town of Italy, in the province of Perugia, capital of the district of its own name, on the side of a steep hill, on the left bank of the Tessino, 61 miles N.N.E. of Rome. It is commanded by a strong castle, seated on a height, which is separated from that on which the town stands by a deep gorge, and approached by a bridge of extraordinary height, along which an aqueduct has been placed. The houses are in general indifferently built, and the streets are narrow and uneven. The principal edifices are the cathedral, in a commanding situation, with a façade formed by five Gothic arches, supported by Grecian columns; the Gothic churches of San Dominico and San Giovanni; the collegiate church of San Pietro outside the town, with a profusely sculptured front; and the citadel already mentioned, now chiefly used as a prison. The only manufacture, and that not of much importance, is hats. Pop. (1881), 7696.

**SPONDEE**, in prosody, a foot consisting of two long syllables, as *omnes*. See RHYTHM.

**SPONDILAS**. See HOG-PLUM.

**SPONDYLUS**, a well-known genus of Lamelli-branchiate (which see) shells, one species of which (*S. Americanus*) is sometimes known by the name of Thorny Oyster. The Spondylus is included in the oyster family (*Ostracidae*), and is recognized by the inequivalve (see SHELL) shell, which is fixed by the right valve to rocks, &c. The beaks of the shell are separate and expanded, and the hinge-teeth number two in each valve. The shell is solid and thick, and readily distinguished by the prominent *spines* with which it is covered. Familiar species are the *S. regius*, *S. radians*, *S. avicularis*, *S. imperialis*, &c. *S. regius* inhabits the Indian Ocean, and is remarkable for the length and solidity of its spines. Most of the other species occur in the warmer seas.

**SPONGE**, the name given popularly to the horny skeletons, formed of a substance known as *keratode*, which are produced by certain animals living in the sea and of very low grade in the scale of life, these animals themselves being also known by the same name. The exact biological position of the Sponges for long formed subject-matter for argument and debate amongst naturalists. Formerly they were with one consent relegated to the plant creation, but it is now beyond all dispute that sponges are members of the animal and not of the vegetable kingdom. Down to a quite recent period they were classified amongst animals with the Protozoa, or lowest group of animals; but all naturalists now treat them as a separate phylum or sub-kingdom (which see), under the name Porifera, given to them because of the water-pores with which they are provided in such abundance. The Sponges—whatever may be their relationship to other forms—include beings the *living parts* of which consist of *sarcoids* or sarcode-bodies—sarcode, or protoplasm (which see), being the primitive substance of which the bodies of lower animals and plants are wholly composed. These sarcode-bodies are united into a *compound mass*, which is traversed by numerous *canals* opening on the surface of the body, the living parts being usually strengthened and supported by *spicules* or needle-like bodies of flint or lime, or by a framework of horny matter. Thus from this definition of a Sponge we, firstly, note that, viewed as to its living parts, it is to be regarded not as a single but as a *compound animal*, formed of semi-independent items united into a composite mass; whilst, secondly, we note the power of this compound living body to secrete or manufacture a framework which varies in its nature and composition. The horny sponge of commerce thus merely represents the dried skeleton of the living parts, these latter parts existing in the living sponge in the form of gelatinous or albuminous sarcode-matter, which coated the sponge externally, and which also lined the internal canals and passages of the structure. The elements or separate bodies of which this *sponge-flesh* or living matter is composed typically consist each of minute pieces of granular sarcode, possessing a solid particle or *nucleus*, and provided with a single eyelash-like filament or *cilium*. And in the simplest sponge which is known, such as one of the Calcareous sponges, we find a colony of such bodies uniting to form a cup-shaped skeleton, the walls of which are perforated by numerous *pores*, whilst the mouth of the cup constitutes one great excretory orifice or *osculum*. When a fragment of living sponge is viewed by aid of the microscope a constant circulation of water is seen to be carried on within the organism. Thus when we look at any ordinary sponge we may at once distinguish two sets of holes or apertures in the horny skeleton. We may note the presence of comparatively few apertures of large size. These are named *oscula*: whilst we can as readily distinguish the sponge-substance to be literally riddled in all parts by an immense number of very small holes, which are named *pores*. In a living sponge, therefore, we find that the *pores* are the *inhalant* orifices, and that through these apertures continual currents of water are being drawn into the interior of the sponge; whilst from the *oscula*, which are *exhalant* apertures, we are able to distinguish currents of water as incessantly being ejected from the organism. To these phenomena the collective term of *circulation in the sponge* is applied, and when we consider its further details we find that a certain mechanism partakes in the process. Thus beneath the upper layer of the sponge, and in the walls of those canals into which the *inhalant pores* open, we find little chambers excavated in the walls

or sides of the canals. These chambers are lined with living sponge-particles which each possess the cilium or delicate vibratile filament already noticed; and by the constant movement of these filaments to and fro in the water currents are at once drawn in by the pores, sent onwards to traverse the sponge-substance, and finally ejected by the oscula. There can be little doubt that these ciliated chambers represent the essentially typical and most vital parts of the sponge; and the uses of the circulation thus set in operation may be briefly summed up by stating, firstly, that nutritive particles are thus drawn into the organism, and serve the being for food; secondly, the constant renewal of the water may subserve a process analogous to that of respiration or breathing in higher forms; and thirdly, by aid of these currents the reproduction of the Sponges (to be presently described) is in some degree aided. Sponges reproduce themselves after two chief modes. The *asexual* form of this process, or that in which the elements of *sex* take no part, is well exemplified in the Fresh-water Sponge or *Spongilla*. In winter the deeper substance of the sponge is found to be occupied by certain bodies of rounded form, each consisting of an outer capsule, strengthened by spicules which are themselves embedded in an outer layer of sarcode. These bodies are known as *spores* or *gemmules*, and contain in their interior masses of cells, the central ones of which are seen to contain *germs*. In spring these spores are discharged from the economy of the parent-sponge, and the contained germ-cells escape from their capsule into the water through an aperture existing in the capsule, and to which the name of the *hilum* is given. Each little germ, thus liberated, soon attaches itself to some fixed object, and becomes a new *Spongilla*. Particles of the living sponge-matter may also simply become detached from the walls of the canals of the sponge, and be carried onwards by the water-currents which sweep through the organism—these particles simply attaching themselves and producing the characteristic features of the parent. This latter is a simple process of *fission*, or division of the body-substance. The *sexual* form of the reproductive process in Sponges is effected (as has been well studied by Hæckel of Germany in the Calcareous or Limy Sponges) by means of true ova or eggs representing the female element, and *spermatozoa*, representing the male elements. These elements of sex are contained in one and the same sponge, the ova or eggs being found generally within the *endoderm* or inner layer of the sponge-body; whilst the spermatozoa are formed from the modified cell-elements of that structure, and appear as microscopic filaments with rod-like heads. The contact of the ova and spermatozoa within the sponge-body impregnates or fertilizes the former, and the egg of the sponge appears to undergo the process known as *segmentation of the yolk*, which until recently was believed to be peculiar to the development of animals above the Protozoa only. A *blastoderm*, or germinal membrane capable of forming all the future structures of the adult sponge, is thus developed, and soon the young sponge appears as an elongated body, termed a *Planula*, the outer cells of which are provided, like the typical sponge-particles, with *cilia*. In this *Planula*, which now leaves the body of its parent, a central cavity is excavated, and when this opens by a mouth at one end the young sponge appears as a little cup-shaped organism, having the cells of its outer wall provided each with a filament or cilium, and having a mouth opening into a central body-cavity. Such an organism is termed a *Gastrula*, and it already has the essential form and features of the adult Calcareous Sponge. For when it roots itself by its closed end;

when the outer cilia disappear, and the outer wall becomes more solidified; when spiculae are formed within the walls of the body; and lastly, when pores appear in these walls, and water begins to circulate through them and to be discharged by the great mouth or single *osculum*—the larval sponge has assumed the form of the adult and perfect organism.

The classification of Sponges is a matter still unsettled. Bowerbank divided them arbitrarily, from the nature of their skeleton, into the Ceratosea, or Horny Sponges; the Calcareae, or those in which the horny skeleton of the Ceratosea is replaced by lime; and the Silicea or Vitrea, in which the skeleton is flinty in its nature. The newest classification appears to be that of recognizing three groups—the (a) Myxospongiae, in which no skeleton of any kind exists, represented by the Halisarcas; (b) the Calcispongiae, or Limy Sponges, which have no horny skeleton, but are composed of limy spicules (such as the Ascones, Leucones, and Sycones); whilst the last and by far the largest group is that of the (c) Fibrospongiae, or those in which a fibrous skeleton exists, strengthened usually by flinty spicules. This latter group includes the true Siliceous or Flinty Spongida of the former classification. The only fresh-water sponge is the well-known *Spongilla fluviatilis*, common as a greenish mass in canals and fresh-water docks. All others are marine, and amongst the more familiar genera we find *Halichondria*, common in British seas, of which *H. palmata*, *H. oculata*, and *H. infundibulum* are well-known species. The genus *Grantia* also includes familiar Sponges; and the Neptune's Cup Sponge, forming a very large cup-shaped form (*Thalassema Neptunei*), are also familiar forms. The Siliceous Sponges are mostly found in the deep sea; many of them have long spicular appendages of flint. A very beautiful and elegant vase-like form of Siliceous Sponge is the Venus' Flower-basket (*Euplectella*), seen in all museums; and other deep-sea Sponges are *Holtenia* and *Pheronema*, which anchor themselves to the sea-bed by means of beard-like appendages of spicules. An aberrant group of Sponges is seen in the Clionidae, or Boring Sponges, which have no fibrous or horny skeleton, but are provided with siliceous or flinty spicules of a form which adapts them for boring into the shells of Mollusca. And equally curious are the Hyalonemadae, or so-called 'Glass-rope Zoophytes,' which by some naturalists are placed in the order Zootharia of the Coelenterate sub-kingdom, and which consist each of a cup-shaped sponge-body (known as *Carteria*), attached to which is a beard of siliceous spicules, on which latter part peculiar polype-like animals are invariably found. The question is, whether the sponge or the polypes are parasitic; and the general opinion appears to be that the sponge *Carteria* manufactures the siliceous rope, whilst the polypes are the parasites. As regards the fossil aspects of Sponges they form an exceedingly ancient group of organisms. The Horny Sponges have left, from the soft nature of their bodies, no traces as fossils. The Calcareous or Limy Sponges first occur in Silurian rocks, and attained their greatest development in the chalk rocks; whilst the Siliceous or Flinty forms are first met with in Mesozoic rocks, and are well represented in existing oceans. *Archæocyathus Minganensis* of the upper Cambrian system of Canada is one of the oldest Sponges, and *Calathium* is an allied genus. The Siphonidae of the cretaceous system, and the Ventriculites, also from the chalk, are the best-known genera of mesozoic age. Shells apparently riddled by Boring Sponges like Cliona occur in Silurian rocks. Of the sponges esteemed in commerce the Turkey and West India sponges are the best known. The former variety includes the finest sponges, which

are distinguished by the finer nature of the horny matter, and the smaller size of the oscula. The eastern parts of the Mediterranean Sea form the chief sources of supply of Turkey sponges, the exporting ports being in Candia and Cyprus, Anatolia, and the Grecian Archipelago generally. Notably the sponges of Symia, a small island, are said to be of very superior quality. The Syrian coast also supplies very fine specimens, and coarser varieties come from the North African coasts and from the shores of Barbary, Algiers, and Tunis. Large coarse sponges of the 'honey-comb' texture, so well known, constitute the chief products of the Florida and Bahama sponge-beds. Sponges are most commonly obtained by diving, and the modern apparatus for diving are now coming into use in some places.

**SPONSORS**, those who 'promise and vow' in the name of the baptized. They are also called god-parents (in old English godsibs or gossips; that is, god-relations) and sureties. (See GOD-FATHER and GOD-MOTHER.) To the remarks contained in that article we will only add, that when the person baptized is an adult the sponsor answers for his religious belief. Some suppose that sponsors came into use in the first centuries of Christianity, when the assurance of a Christian of known character, that those who presented themselves for baptism were worthy of it, was considered requisite. This surety was also to answer for their further instruction. But Neander, in his General History of the Christian Religion and Church, says that sponsors were probably introduced with the baptism of infants, in order to make a profession of the Christian faith in their name, and to guarantee their religious education. Tertullian, who opposed the baptism of infants, mentions the case of the sponsors as one of the objections, because they must take upon themselves an obligation which they may be prevented from fulfilling by death or the sinfulness of the god-child. The Roman and Greek Catholic churches consider the relation of the sponsor to the god-child a kind of adoption, and therefore forbid marriage between them. Between the sponsors themselves they do not allow marriage to take place. The Catholics sometimes take a sponsor for confirmation.

**SPONTANEOUS COMBUSTION.** See COMBUSTION (SPONTANEOUS).

**SPONTANEOUS GENERATION.** See GENERATION (SPONTANEOUS).

**SPONTOON** (Italian, *spuntone*, pointed), the half pike carried by infantry officers from the end of the seventeenth to the end of the eighteenth century. They were used for signalling orders to the regiment; a spontoon pointing forward signified advance; pointing back, retreat; placed upright in the ground, a halt; and so on. Their use was discontinued in the British army in 1787, and in the French about two or three years later.

**SPOONBILL** (*Platalea Leucorodia*), a genus of Wading Birds, included in the Heron family (Ardeidae) and in the sub-family Plataleinae. In this sub-family and genus (*Platalea*) the bill is straight, flattened, and expanded at its tip—the conformation of the bill giving to these birds their popular name. The upper mandible overhangs the lower one, and the bill is grooved on the upper surface, the groove commencing at the base of the bill. The second quills are the longest in the wings; and the tarsi possess scales, which are arranged in a reticulate or netted pattern. The toes are connected at their bases by membranes. The Common White Spoonbill above designated is the familiar species. This bird, which attains an average length of about 30 inches, occurs rarely at the present time in England, but is found very generally distributed over the Continent, and in

Africa and Asia as well. In Holland it is particularly plentiful. The colour is a pure white, tinted with a very soft pink, the breast being yellow coloured, as also is the naked patch of skin on the throat. The legs and feet are black, the eyes being red, and the bill—about 8 inches in length—being black and yellow at its expanded tip. A tuft or crest of feathers is seen on the posterior part of the head. The food consists of Molluscs, Crustacea, worms, &c., which these birds pick up on the muddy flats and in the shallow waters of the sea-coasts in which they wade. They also appear occasionally to eat vegetable matters. The nest is generally found in open situations, the eggs numbering four, and being coloured of a grayish-white hue, spotted with brown. The Roseate Spoon-bill (*P. Ajaja*), inhabiting South America, is another species of these birds, and is distinguished by its rose-coloured plumage and wings of a rich carmine hue. The Boat-bill Heron (*Cancroma cochlearia*) belongs to an allied genus of Waders, and possesses a large beak, which, in general conformation, has been compared to two boats placed together, the keel of the uppermost boat forming the ridge of the upper mandible.

**SPOON-WORM**, the name applied to certain peculiar worm-like animals, the exact zoological position of which is very difficult to define. The most usual position which has been assigned to these forms is that of including them in a special order of the class Annelida—this order named Gephyrea or Sipunculoidea—being the lowest division of the Worm class. These animals are distinguished by the fact that the body may or may not be distinctly segmented as in the true worms. No appendages of the nature of 'foot-tubercles' exist, and no ambulacral or water-vascular system is developed. The nervous system, whilst, as in Annulosa, consisting of a ventral cord of nervous matter, does not present any ganglionic enlargements or 'nerve-knots' as in Annulosa generally. The skin is soft, and does not secrete any calcareous or limy covering; and the sexes are distinct in the spoon-worms, the young undergoing a metamorphosis in the course of their development. Three chief groups of these forms were recognized by the late Professor Edward Forbes. The first group or Sipunculacea, represented by the well-known genus *Sipunculus*, is distinguished by its members possessing a retractile proboscis, which is provided with a circle of tentacles at its tip, the arms being situated at the base of the proboscis. The *Sipunculus Bernhardus* is a familiar form, found inhabiting the sand of most of the seas of Europe. Some species of this genus may attain a length of 1 foot, whilst others do not exceed  $\frac{1}{2}$  inch in size. This species inhabits the cast-off shells of molluscs, and one species—the Edible *Sipunculus*—is said to be eaten by the Chinese. Forbes' second group is that of the Priapulacea, represented by the genus *Priapul*, which possesses a retractile proboscis, destitute of tentacles, and having the arms situated at the end of an elongated tail or appendage. The body is obtusely shaped behind, and the tail is branched or pointed. *P. caudatus* is the familiar species, and is found in southern seas. The third and last division of the spoon-worms is that of the Thalamosemacea, a group distinguished by possessing a proboscis terminating in a very large fleshy appendage. No tentacles exist, and the anus opens at the hinder extremity of the body, which is of cylindrical rounded form. *Thalamosema Neptuni* is a familiar species, and is sometimes distinctively named the 'Spoon-worm' from the presence of the appendage of the proboscis. Two hook-like bristles exist behind the proboscis. This species, along with allied forms found on our coasts, is used as a bait by fishermen.

**SPORADES**, the general name for nineteen islands in the Grecian Archipelago, lying to the east of the Cyclades. The principal are Scio, or Chios, Samos, Cos, Rhodes, Lesbos, and Patmos. (See the articles.) The name Sporades is derived from the Greek *speirein*, 'to sow,' indicating the scattered position of the islands.

**SPORADIC**, the term applied to those diseases which occur in single and scattered cases, in opposition to those which affect many persons at the same time.

**SPORES**, the name applied in zoology to the germs of many of the lower animals, such as Infusoria, which, together with plant spores, may be borne in immense quantities by the atmosphere. The presence and nature of these spores becomes a subject of much interest to the biologist from the fact that their development in fluids in which decaying organic matter is contained has given rise to the question of spontaneous generation (see GENERATION, SPONTANEOUS) or Heterogeny. The difficulty of tracing the full development and history of these minute germs has led to the formation and promulgation of many hypotheses explanatory of their development. But it may be definitely stated that whether the fact of the *spontaneous* production of animals and plants be ever proved or not the decision of this point in either direction cannot affect the stable fact that the spores of the lower forms of life are present in immense quantities in ordinary atmospheric air—invisible in ordinary diffuse daylight, but readily perceptible when scientific appliances are brought to bear on their discovery. The subject of spores in connection with their development has also grown largely in importance since the promulgation of the 'germ theory of disease,' which professes to account for the origin, and more especially for the *spread*, of contagious and epidemic diseases—such as small-pox, fevers, and the like—by the idea of their *sporadic* origin. In this view, which is strongly supported by biological research, such diseases have an organic origin, and in their history and progress evince a strong natural likeness to the growth and development of plant and animal life. Professor (Lord) Lister's recognition of the 'germ theory of disease' in his practice of *antiseptic surgery* led him to employ *carbolic acid* dressings after the performance of operations, and for the treatment of wounded surfaces, on the principle that the carbolic acid acts as an antiseptic in destroying the atmospheric germs of animal or plant life, which, gaining contact with the wounded or raw surface, are believed to be the cause of suppurative and other conditions unfavourable to the healing process.

**SPORES**, in botany, the minute grains in cryptogamous plants which perform the function of seeds. These germinating bodies do not contain an embryo, but consist merely of one or more cells variously combined together; hence they are called spores to distinguish them from the true seeds of the phanerogamous or flowering plants. They are small, often so minute as to be invisible to the naked eye. They frequently remain capable of germinating for many years, and of enduring much drought without destruction. They germinate either by elongation of some particular part, and subsequent cell-division, or by cell-division without any protrusion of a thread or membranous expansion. In the parent plant they are either scattered singly, or are united in a fruit-like envelope called the *sporangium*, or spore-case.

**SPORTS, THE BOOK OF.** The founders of the Reformation in England, after abolishing most of the church festivals kept before that time, had made little or no change as to the mode of observing those which had been retained. Sundays and holidays stood much on the same footing, as days on which

no work except for good cause was to be performed, the services of the church to be attended, and any lawful amusement might be indulged in. A distinction, however, soon sprang up; an industrious people could spare time for very few holidays, and the more devout party of the nation, while they alighted the church festivals as of human appointment, prescribed a stricter observance of the Lord's-day. But it was not till about 1595 that they began to place it very nearly on the footing of the Jewish Sabbath, interdicting not only the slightest action of worldly business, but even every sort of pastime and recreation,—a system which, when promulgated, soon gained ground as suiting the humour of the Puritans, then rapidly rising into importance as a party in the nation. The conduct of some Puritan authorities in Lancashire, who persisted in illegally suppressing, instead of regulating, the customary recreations of the people, excited grave discontent, and increased the influence of the Roman Catholics by giving a repulsive aspect to the Reformed religion. This led in 1618 to the interference of James I., who issued a Declaration popularly known as the Book of Sports, which was to be read in the churches, permitting dancing, archery, May-games, morrice-dances, leaping, vaulting, and other lawful games to be indulged in on Sunday after divine service; but prohibiting bear-baiting, bull-baiting, bowling, and interludes. No recusant or any one who had not attended church service was allowed to take part in the games. The order to read this declaration was not enforced during the king's reign, and the clergy seem to have generally abstained from reading it. But under the rule of Charles I. and Laud it was republished, and the reading of it was enforced with great severity. This excited among the Puritans an amount of indignation and opposition which contributed in no small degree to the overthrow of the monarchy and the church. In 1644 the Long Parliament ordered all copies of it to be collected and publicly burned.

**SPOTISWOOD (or Spotswood), JOHN**, Archbishop of St. Andrews, born in 1585 of an ancient family, in the parish of Mid-Caldor, in the county of Mid-Lothian, studied at the University of Glasgow, and at the early age of eighteen became assistant to his father as parson of Caldor. At his outset in life he professed himself a zealous supporter of the Presbyterian party, and even seemed inclined to proceed faster than some of his more moderate colleagues were able to follow. He appears, however, to have soon changed his ground, and in 1601, when the Earl of Lennox was sent as ambassador to France, Spotiswood not only accompanied him as chaplain, but, according to Calderwood, so far forgot himself when in Paris that he 'made no scruple to go in to mass.' On his return he was complained of to the General Assembly, but through the influence of the court escaped with merely a reprimand. He was now a favourite at court, and in 1603, when King James set out for England, was one of the five Scottish clergymen selected to accompany him. In the course of the journey news arrived of the death of the Archbishop of Glasgow, and Spotiswood was immediately appointed his successor, and in consequence returned to Scotland, but was not consecrated till 1610. The year before this transaction he had been appointed one of the extraordinary lords of session, but shortly after resigned the appointment on the erection of two courts of High-commission, of one of which he was appointed president. In October, 1614, he caused John Ogilvie, a Jesuit priest in Glasgow, to be apprehended for refusing to deny the temporal power of the pope, and took a leading part in his examination, which ended in the condemnation and execution of the unfortunate priest in the spring

of 1615. In 1615 he exchanged Glasgow for the metropolitan see of St. Andrews. In 1618 he presided at the General Assembly that met at Perth, and succeeded in carrying the five points of ecclesiastical discipline known as the Perth Articles (see PERTH, THE FIVE ARTICLES OF); but all his authority could not command obedience to them, though he continued to enforce them before the High-commission court for a number of years, depriving many ministers of their livings for non-compliance. The favour which he had enjoyed under King James he continued to enjoy under his son Charles I., whom he crowned in the Abbey church of Holyrood in 1633; but his zeal appears to have outrun his discretion, and by his harsh procedure against Lord Balmerino, in which he was generally believed to have been influenced by feelings of private revenge, he contributed greatly to inflame the opposition to episcopal government, which now became general among all ranks, and finally led to its overthrow. In 1638, at the famous Assembly held at Glasgow, he was deposed, excommunicated, and declared infamous. He saved himself by flight, and took up his residence in London, where he died in 1639. He is now remembered chiefly as the author of a History of the Church of Scotland, commencing at 203 and continued to the end of the reign of James VI. The greater part of it relating to the transactions of Spotiswood's own period is not without interest, but its statements are obviously partial, and therefore of little authority.

**SPOTTED FEVER**, the name of a form of typhus fever, and also of a quite different disease otherwise known as cerebro-spinal fever or black sickness. The latter fever is probably contagious, and certainly occurs in an epidemic form. It is rare after forty years of age, and is not uncommon among young children. The symptoms are due to inflammation of the membranes of the brain and the spinal marrow. The disease may begin with feverishness, headache, pains in the back and limbs, and feelings of illness lasting for a few hours or a couple of days before anything serious is feared. Usually, however, the attack is sudden, coming on with collapse and insensibility or with severe shiverings, intense headache and dizziness, excessive pain in the back of the neck and along the spine, constant vomiting, pain in the stomach, and cramping of the muscles of the legs. The skin is over-sensitive, so that slight touches give rise to complaints of pain. One marked symptom is a stiffening of the muscles of the head and back, so that the patient's head and neck are arched back. A rash of blebs appears on the lips. Purple spots come out about the second day, appearing first on the legs. The disease is extremely fatal. Energetic treatment at the outset may relieve the brain, and therefore there must be no delay in seeking skilled advice. Death may occur from collapse within a few hours, or from the first to the seventh day. If the attack begins with collapse, heat should be applied to the limbs and over the heart, and small quantities of stimulants should be administered. When this stage is over, the pains in the head and back are relieved by ice-bags on the back of the head and along the spine. To adults opium, and to children bromide of potassium, may also be administered.

**SPOUT-SHELL**, or **PELICAN'S FOOT** (*Aporrhais Pes-Pelecani*), a genus of Gasteropodous Molluscs, belonging to the family Cerithiidae, and to the Holostomatous group of the class. This shell has its aperture produced into a spout-like process in front, and hence derives its popular name; whilst the general shape, produced by its elongated spines, together with its whitish colour, have suggested the name 'Pelican's Foot Shell.' The characters of the genus are found in the long spine of the shell, in the expanded

outer lip, and in the finger-like projections of the shell.

**SPRAIN**, or **STRAIN**, the partial displacement or twisting of a joint with stretching, and more or less injury to the articulating apparatus; the ligaments, tendons, and their sheaths being all involved in the injury, while sometimes even small portions of the articulating processes of bones are separated. All joints are liable to this accident, but the wrist and ankle are most frequently the seat of this injury; their liability arising from their immobility, compared with such a joint as the shoulder, which is more liable to dislocation. A sprain is attended with violent pain, and the sufferer feels sick and faint. Swelling and discoloration rapidly take place from extravasation of blood into the sheaths of the tendons and the other surrounding tissues, in consequence of laceration of the smaller blood-vessels. Subsequently the swelling is kept up in consequence of the effusion of serum from the incited action which occurs. Thus the joint is much deformed, and great care is required in examining the parts to guard against mistakes and to gain an exact knowledge of the nature of the injury so as to ascertain decidedly and at once whether it be a simple sprain, or whether there be fracture or dislocation. If it is a simple sprain the part affected should be laid in an easy position on a pillow, and confined in that position by broad slips of bandage crossing the limb and pinned at each end to the sides of the pillow. The part should at first be fomented for an hour or two with cloths wrung out of warm water; afterwards it is to be wrapped in cloths wetted with a warm lotion, say of sugar of lead, 1 dram; opium, 1 dram; and boiling water, 1 quart. These cloths when applied should be covered with oiled silk or cotton to prevent evaporation. Absolute rest is the principal point to be attended to. To secure this, when there is much restlessness, it sometimes becomes necessary to use splints. Leeching or even general bleeding may become necessary, should inflammatory symptoms appear; but leeching in the first instance, with a view to remove what is termed the bruised blood, is absurd; the blood is absorbed into the surrounding cellular tissue, and cannot be removed by that means, but is gradually absorbed in the process of cure, when the variation of discoloration from black and blue to greenish and to yellow, &c., takes place. If the part be kept at rest from the first, and fomented as directed, the pain soon abates and the swelling gradually disappears; then gentle rubbing with soap and opium liniment may be had recourse to, and the part should be lightly bandaged with a flannel roller. If inflammation sets in, six, eight, or ten leeches may be applied around the joint, and if the patient is of full habit a few doses of purgative medicine should be given. The joint often remains weak and stiff for a length of time; then stimulating frictions will be found useful, together with the practice of pouring water on the part from a height; in doing this it is well to commence with warm water, and after a time gradually to reduce the temperature till the patient can bear it cold from the well. After each application the part must be well rubbed, as otherwise the part may become rheumatic; indeed, rheumatism is a very common occurrence in parts injured by sprains and fractures. Too great caution cannot be applied in bringing a joint which has been sprained into use, as many diseases of joints are brought on by mismanagement and too early exercise of the affected parts.

**SPRAT**, or **GARVIE** (*Clupea Sprattus*), a well-known species of fishes of the Herring genus (*Clupea*), which, like the latter form, occurs on the British coasts in vast shoals from July to February and March. The fishing chiefly commences in November, and is

carried on, like that of the Herring, by means of large nets. In some instances the capture of sprats has been enormous, and far in excess of the demands of the British markets; and in these cases the fishes are sold to the farmers, and spread on the land as manure. The sprats were long thought to be merely the young of the herring and its allies; but the presence in the sprats of the sharply-notched edge of the belly is a character sufficient for their clear distinction from the young of the herrings, &c. Its general colour resembles that of the herring, but it is of invariably smaller size. The flesh is very nutritious and palatable. The sprat fishery of the Frith of Forth is very extensive; and on the coasts of Essex, Kent, and Sussex in England it is pursued in an equally active manner.

**SPRAT-SUCKER** (*Lerneatoma spratti*), a genus of Lower or Parasitic Crustaceans, belonging to the Lerneæ (see LERNEÆ), and so named from its habits of infesting the eyes of sprats, which it completely destroys, burrowing into their substance by means of its barbed head.

**SPREE**, a river of Germany, which rises in the east of Saxony, on the north side of the Riesengebirge, near New Salza; flows very circuitously N.N.W., passing the town of Lobau, enters the Prussian province of Brandenburg, passes the towns of Spremberg, Kottbus, Lübben, where two branches, by which it had previously formed an island, called the Spree-Wald, again unite. Beyond Lübben it describes a semi-circle which terminates in the Lake of Schmielung; then proceeds north past Beeskow and W.N.W. past Fürstenwalde and Köpenick, traverses Berlin, and a little below Charlottenburg joins the left bank of the Havel at Spandau, after a course of nearly 200 miles. It has no affluent of any consequence. The Friedrich Wilhelm Canal connects it with the Oder a short distance above Frankfurt.

**SPRING**, one of the seasons of the year which, astronomically speaking, begins when the sun, in its ascent, crosses the equator, and ends when it reaches its highest position in the heavens at mid-day, that is to say, it lasts from the vernal equinox to the longest day. In this country March, April, and May are reckoned the spring months of the year; but the variability of the climate renders the period of the real approach of spring a matter of great uncertainty. In the southern hemisphere the astronomical spring begins September 23, and ends December 21; thus it falls about the time of our autumn. Under the equator, and in general in the torrid zone, the seasons of the year are not divided in the same manner as in the temperate. They are distinguished into the dry and wet seasons. See SEASONS.

**SPRING**, in mechanics, an elastic body, made of various materials, as steel, india-rubber, &c., and used for various purposes—diminishing concussion, as in carriages; for motive power, acting through the tendency of a coiled metallic spring to unwind itself, as in clocks and watches; or to communicate motion by sudden release from a state of tension, as the bow to the arrow, the gunspring to the cock, and many other instances; others are employed as regulators to control the movement of wheel-works, as the balance or hair-spring of watches; to measure weight and other force, as in the spring-balance.

**SPRING**, in navigation, implies a crack running transversely or obliquely through any part of a mast or yard, so as to render it unsafe to carry the usual quantity of sail thereon. *Spring* is also a rope passed out of a ship's stern, and attached to a cable proceeding from her bow, when she lies at anchor. It is usually employed to bring the ship's broadside, or battery of cannon, to bear upon some object, as another ship, a fortress, &c. When a ship rides by

anchors which are only attached to one end she will move according to the direction of the wind or tide. Now, if a rope be extended from the other end to the same anchor, it is evident that, by slackening one of these ropes and keeping the other fast, her side will lie more or less obliquely to the wind or tide, as occasion may require, so as to be opposed to any distant object to the right or left. *Spring* is likewise a rope extending diagonally from the stern of one ship to the head of another which lies abreast of her at a short distance, and is used to make one of the ships sheer off to a greater distance from the other. Springs of this kind are occasionally applied to a wharf or pier for the same purposes. To *spring a mast, yard, &c.*, is to crack it.

**SPRING**, in physical geography, see SPRINGS.

**SPRING-BALANCE**, an instrument in which the downward pressure of a body is balanced by the resistance of a spring or springs, and which by indicating the amount of distortion indicates the pressure. Inasmuch as the attraction of gravity (what is called gravity is really the resultant of gravity and centrifugal force), varies on different parts of the earth, being less at the equator than at the poles, a spring balance could not be constructed to answer the purposes of a beam and scales exactly; but such balances appear to serve useful purposes on account of their compactness and the facility with which approximate weighings may be made by their means. To render spring balances tolerably reliable there appear to be some improvement needed in the machinery by which the larger instruments indicate the stretch of the springs, an easy means of adjusting the instrument when, either from wear, or from rusting of the springs, or from a set in the springs, or from differences of temperature, the index is out of adjustment. Various forms of spring balance are employed to measure forces. See DYNAMOMETER.

**SPRING-BEETLES** (*Elatride*), the name given to a group of Beetles or Coleoptera, belonging to the Pentamerous section of that order. They are so named from the springs they are enabled to take, when laid upon their backs, by means of the *prosternum* or front portion of the thorax being prolonged to form a spinous process, by the movements of which these insects are enabled to execute their active leaps. The body is horny in these beetles, the antennæ being short and serrated, and the head retracted into the chest as far as the eyes. The limbs are very short. The larvae of many of these beetles are wood-borers.

**SPRINGBOK** (*Antidorcas* or *Gazella Eudhore*), a well-known and elegant species of Antelope, deriving its name from its habit of leaping when pursued or alarmed. This species is found in South Africa in the flat or table lands, often assembling in vast flocks, numbering several thousands in each herd. Occasionally these animals appear to make regular migratory journeys of indefinite kind, and in such cases are led by appointed leaders. The colour of the springbok is a rich brown on the back, the abdomen being white, whilst the sides are of a reddish-brown hue, produced by the merging of the two chief colours. The croup is covered by long hairs, which become especially prominent when the animal leaps. The tear-bag or *crumen* is small. The white colour of the belly is continued up the back and rump in the form of a marked white stripe. The head is white, and possesses a streak of dark brown on each side, this streak passing from the base of the horns through the eye and to the corner or angle of the mouth. The horns are ringed or annulate, are of black colour, and in the adult male are larger than in the female or young male. The horns in the young animals are not so markedly lyre-shaped as in the older forms. The food chiefly consists of the shorter

grasses of the plains. These animals are largely pursued and hunted both by man and by lions, leopards, and other Carnivora. The flesh is highly palatable, and the hides are in request by the savage races of Africa as well as by civilized man for various useful purposes. The full-grown animal will weigh from 60 to 80 or 90 lbs. Barrow mentions that on one occasion he saw from 10,000 to 15,000 of these antelopes near the fields of the Cape Colonists, whilst Gordon Cumming described a herd he witnessed as taking two hours to pass his point of observation in an 'unbroken, compact phalanx'.

**SPRINGFIELD**, a city of Hampden county, Massachusetts, United States, beautifully situated among rich alluvial meadows, on the left bank of the Connecticut, here navigable and crossed by two bridges, and the centre of several railways, about 20 miles north of Hartford, and 98 miles west-by-south from Boston. Main Street stretches nearly 3 miles parallel to the river, though at some distance from it, and contains many elegant buildings. It is intersected at right angles by several other streets, and has also behind it, where the ground rises so as to command a view of the valley, several ranges of handsome residences. There is here the United States armoury or arsenal, finely situated on a height about  $\frac{1}{2}$  mile east of Main Street, and consisting of an imposing pile of brick buildings arranged round a square. Here from 250,000 to 275,000 stand of arms are stored, and from 120,000 to 150,000 are annually manufactured. The mills, foundries, and workshops connected with the armoury are the most important industrial establishments of the town, but the extensive water-power furnished by Mill River, which here joins the Connecticut, is also employed for various other purposes, as iron-works, machine-shops, paper, cotton, and other mills. In the vicinity of the railway station is a large manufactory of cars and other requisites of railways. Pop. (1900), 62,059.

**SPRINGFIELD**, the capital of Illinois, United States, on the edge of a large and beautiful prairie on the Illinois, and on the railway to Naples, 96 miles N.W. of St. Louis. Its public edifices include a state-house, in the centre of the square; a beautiful court-house, state-bank, the high school and other first-class educational establishments, jail, market-house, the national monument to Abraham Lincoln, at one time a resident here, &c. Among the manufacturing establishments are flour and woollen mills and foundries; the trade also is extensive. The rich prairies in its neighbourhood contain large quantities of bituminous coal. Pop. (1890), 24,963.

**SPRINGFIELD**, a city, capital of Clarke county, Ohio, United States, on the east fork of Mud River, and at the junction of several important lines of railway, 43 miles west by south of Columbus. It has sixteen churches, the Wittenberg Lutheran College and Theological Seminary; a handsome court-house and other public buildings; numerous mills and manufacturing establishments; and an extensive trade in grain, cattle, and hogs. Pop. (1890), 31,895.

**SPRINGS** are outflows of water or other liquid from the earth. The invisible vapour which rises from the land and water ascends in the atmosphere till it is condensed by the cold into clouds, which restore it again to the earth in the form of rain, hail, and snow. Part of this moisture is re-absorbed by the air, part supplies the wants of animal and vegetable life, a portion is carried off by the streams, and the remaining portion sinks through porous soils till it arrives at a stratum impervious to water, where it accumulates in subterranean lakes, frequently of great extent. In virtue of the law of gravity water ever tends to lower levels, and thus what gathers in the higher portions of the earth's crust finds its way

in process of time through rents and crevices, and springing forth holds on its course to the valleys below. Where there are no impervious strata in the higher lands to interrupt its downward tendency it often percolates to great depths, and far below the surface of the adjacent valleys; but sooner or later it is interrupted by some obstructing stratum, and there, in obedience to hydrostatic pressure, it bursts through the nearest outlet and rises to the surface with a force proportionate to the height and volume of the accumulated waters. In boring Artesian wells the water often rushes up with such impetuosity by the hydrostatic pressure as to form jets of 40 to 50 feet high. In whatever manner water may gather below the earth's surface and then find its way back through it, the outlets are all known as springs; and these springs occur at all levels, even below the bed of the ocean, in many parts of which there exist springs of fresh water.

It is usual to speak of springs as surface springs and deep springs, as perennial, intermittent, hot, cold, mineral, and so on. Surface springs are those which issue from superficial beds of sand, gravel, and the like, and being immediately dependent for their supplies on the amount of rainfall are often very feeble or altogether dry in summer, though gushing out copiously during winter. Deep-seated springs, on the contrary, being less directly influenced by summer's droughts or winter's rains, flow steadily at all times. Perennial springs, as the name implies, are those that flow on year after year without signs of abatement. They are evidently deep-seated, and many that were celebrated by the ancients flow as copiously now as they did thousands of years ago. Intermittent springs are those which differ periodically in the amount of water they deliver, or which even cease entirely to flow for a time. This is explained by the supposition that there are cavities or basins under the earth filled from above and emptied by siphon-shaped outlets. These empty the basin as far as the nature of the siphon permits, then cease to flow until the leg connected with the basin is again filled to its highest point. (See SIPHON.) If the siphon conducts the water to a great distance it may flow in dry weather and cease in wet. The ebb and flow may also be regulated by the tide, as at Richmond, where the rise at high water is observed in the wells which flow from the sand strata on the banks of the Thames. Surface springs generally vary in temperature with the seasons; deep-seated ones, being beyond these influences, are equable at all times. It may be stated in general terms that in summer the crust of the earth, at small depths, is colder than at the surface; that during winter the crust at these depths is warmer than at the surface. At a certain depth the temperature of the crust becomes permanent and equal to the mean annual temperature of the air above. The depth at which this stratum of invariable temperature lies varies, of course, with the latitude. At the equator the effect of the seasons is imperceptible at the depth of a foot below the surface; between the parallels of 40° and 52° the temperature is invariable at a depth of from 50 to 60 feet; and in the high Arctic regions the soil is perpetually frozen 1 foot below the surface. Below this zone of season changes a regular increase in the temperature is observed, at the rate of 1° of Fahrenheit for every 50 or 60 feet of perpendicular descent. Springs whose sources are below the invariable stratum will gradually increase in heat, the deeper being the hottest. Cold springs generally flow from chilled mountain sources; hot or thermal springs, on the contrary, either ascend from vast depths or are situated in the vicinity of volcanic action. Thermal springs,

In some cases hot even beyond the boiling-point of water, occur abundantly and on an extensive scale in Iceland, the Azores, Central Asia, New Zealand, the Andes, and other volcanic regions; they occur also in Britain, the Pyrenees, Germany, and other countries far removed from any centre of volcanic activity. The temperature of hot springs is very constant, and that of boiling springs has remained unchanged for ages; like ordinary springs hot springs are either perennial or intermittent—perennial, like those of the Pyrenees, that have flowed without abatement since the time of the Romans; and intermittent, like the geysers of Iceland and the Rocky Mountains. Water, both hot and cold, dissolves and combines with many of the mineral substances it meets with in the earth, and comes to the surface as mineral or medicinal springs, holding in solution various chemical ingredients; some, for example, are saline, or contain salt; others chalybeate, or contain iron; others siliceous, or contain silica; some calcareous, or contain lime; while others give off sulphurous vapours, or are impregnated with the salts of various minerals and metals. Such are the sulphuretted waters of Harrogate, the brine springs of Cheshire, the borax springs of Tuscany, the travertine or lime-depositing waters of the Anio, the siliceous hot-springs of Iceland and the Azores, and thousands of others that occur in almost every country. To the same category also belong escapes of steam, hot mud, and the like, observed in volcanic districts; and also the discharges of gases, naphtha, petroleum, &c., which generally come to the surface in connection with water, and are seemingly dependent on its percolating and hydrostatic powers. See ARTESIAN WELLS, GEYSERS, NAPHTHA, PETROLEUM, WATER (Mineral), &c.

**SPRING-TAILS**, the name given to a genus of Thysanurous or Lower Insects, of which the *Podura* are the most familiar examples. The insects included under this designation have mouths of a masticatory or biting type, and are distinguished by possessing jointed appendages at the extremity of the abdomen. The *Podura* thus possess a forked tail, by the bending and sudden extension of which they are enabled to effect great leaps, and from the presence of this appendage their familiar name of 'spring-tails' is derived. They are wingless insects; the head being distinct; the antennæ short and four-jointed; the eyes simple, and numbering from six to eight on each side of the head; and the palpi short and composed of a single joint. The body in these insects and in the allied *Lepismidæ* is covered by delicate scales and bristles. The scales are used as 'test-objects' to show the defining powers of microscopes in the definition of the delicate markings which the surface of the scales exhibits. These insects are generally found in damp cellars, under leaves and moss, in snow and ice, and in other moist places.

**SPRING-TIDE**, the periodical excess of the elevation and depression of the tide, which happens soon after the new and full moon. See **TIDES**.

**SPRIT**, a small boom or pole which crosses the sail of a boat diagonally from the mast to the upper aftmost corner, which it is used to extend and elevate. These sails are accordingly called *sprit-sails*. A sail attached to a yard hanging under the bowsprit was also formerly so called.

**SPRUCE** (*Abies*). The spruce-firs are evergreen trees, natives of Europe, Asia, and America, remarkable for their tall, erect, pyramidal forms and profusion of foliage. One or more species are useful, and the rest ornamental. In Britain they flower in May and June, and ripen their cones in the spring of the following year. *A. excelsa* is the Norway Spruce, indigenous to the north of Europe, and culti-

vated in Britain since 1548. There are several varieties of this species, including *Clanbrasiliana*, a low, compact, round bush, seldom higher than 3 or 4 feet. It is said to have been introduced into Great Britain by Lord Clanbrasil about the end of last century. The Norway Spruce-fir is the loftiest of European trees, attaining the height of from 125 to 150 feet, with a straight upright trunk from 2 feet to 6 feet in diameter. The wood of the spruce is considered to be superior in hardness to that of any other trees of the pine and fir tribes. It is light and elastic, of a reddish or yellowish hue, and less resinous than the wood of *Pinus sylvestris*, the Scottish fir. The principal product of this tree is the Burgundy pitch of the shops. *A. Douglasii*, a native of the north-west coast of North America, was discovered by Menzies about 1797, and afterwards by Douglas, by whom it was introduced into Great Britain in 1826. Its leaves are flat, blunt, entire, pectinate, silvery beneath; cones oblong, from 3 to 4 inches in length, and  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in breadth. It is a large conical tree, with a rugged, grayish-brown bark, abounding in balsamic resin. In its native forests it rises from 100 to 180 feet, with trunks from 2 to 10 feet in diameter. *A. Cephalonica*, the Cephalonian Silver Spruce-fir, grows in its native country to a height of 60 or more feet, with a trunk 9 or 10 feet in circumference, and numerous side branches, which, when young, give it the general appearance of an *Araucaria*. It was introduced into this country in 1824 by General Charles J. Napier, when governor of Cephalonia. The Black or Double Spruce (*A. nigra*) is very abundant in Lower Canada, Newfoundland, New Brunswick, Nova Scotia, Maine, and the upper parts of New Hampshire and Vermont. It grows to the height of 70 or 80 feet, with a trunk 1 or  $1\frac{1}{2}$  foot in diameter; and as the summit has a regular pyramidal form a solitary tree makes a beautiful appearance. The timber is distinguished for lightness, strength, and elasticity, and furnishes most of the spars used for vessels in the United States. The Red Spruce is a mere variety of this timber, produced by a difference in soil. It is chiefly with the young branches of this species that the wholesome drink called *spruce-beer* is prepared. The White or Single Spruce (*A. alba*) inhabits the same districts, and also forms great forests in the north and north-west of America. It seldom exceeds 50 feet in height and 12 or 16 inches in diameter at the base of the trunk. The wood is employed for the same purposes as the preceding. It is esteemed in Europe as an ornamental tree, and is frequently cultivated in parks and gardens. The American Silver Fir (*A. balsamea*) is still less than the White Spruce, and rarely exceeds 40 feet in height. It is a beautiful tree, having the leaves longer than those of the Black Spruce, and silvery beneath. The cones are 4 or 5 inches in length, cylindrical, obtuse, and violaceous. The wood is light, but slightly resinous, and is little used. A few bottles of the turpentine are collected and sold under the improper name of *balm of Gilead*; and this remedy has acquired some celebrity in certain stages of pulmonary consumption. The Hemlock Spruce (*A. Canadensis*) is readily distinguished by having the leaves distichous, or disposed in two ranks, and the cones terminal. It is a graceful tree, with timber coarse-grained and poor.

**SPRUCE-BEER**, and **ESSENCE OF SPRUCE**. Essence of spruce is simply a decoction of the young green tops of the Black Spruce (*Abies nigra*) boiled and evaporated to the consistence of a thick syrup. Spruce beer of good quality may be prepared as follows:—Essence of spruce  $\frac{1}{2}$  pint, pimento and ginger (bruised) of each 5 oz., hops  $\frac{1}{2}$  lb., water 3 gallons; boil the whole for ten minutes, then add of moist

sugar 12 lbs. (or good treacle 14 lbs.), warm water 11 gallons; mix well, and when lukewarm add a pint of yeast; after the liquid has fermented for about twenty-four hours it is ready for bottling. This beer is regarded as diuretic and antiscorbutic, is relished by many as an agreeable summer beverage, and often found useful during long voyages. The famous Dantzig black beer is made with the essence obtained from the buds of the Norway Spruce (*Abies excelsa*).

SPUR, an instrument of various well-known shapes, having a rowel or small wheel with sharp points, worn on a horseman's heel, and used for goading the horse. In the age of chivalry gold spurs were the distinguishing sign of knighthood, and it was the ambition of a youth to win his spurs by some gallant deed. A knight, if convicted of cowardice or any dishonourable deed, had his spurs hacked off as a mark of degradation. The true knight's spurs were at his burial laid in the tomb along with him. Spurs are now far less frequently employed than formerly, and even among the cavalry they are little used, unless in the heat of the charge on the enemy.

SPURGE (*Euphorbia*), a genus of exogenous plants belonging to the natural order Euphorbiaceæ (which see), with small monandrous, naked male flowers crowded round a naked female one, the whole placed in a calyx-like involucre. They are milky plants, mostly herbaceous, sometimes shrubby, and not unfrequently succulent and leafless. They are natives of warm and temperate climates; about twelve species are found in Britain; the succulent species are confined to the hottest and driest parts of the world. The most important product of the genus is euphorbium, an acrid resinous drug obtained from certain succulent species, as *E. officinarum*, *E. antiquorum*, and *E. canariensis*. (See EUPHORBUM.) The Caper-spurge (*E. lathyris*) is occasionally met with in Britain; its seeds yield an oil of the most violent purgative nature. The roots of *E. Ipecacuanha*, *E. Gerardiana*, and *E. Pithyusa* are emetic. The juice of *E. heptagona*, *E. virosa* and *E. cercifomis*, African species, and *E. cotinifolia*, a South American species, affords the natives a mortal poison for their arrows. The milky juice of *E. helioscopia*, an annual plant common in Britain, is used to destroy warts. *E. cattimandoo*, an Indian species, yields a kind of caoutchouc. The sap of *E. phosphorea* shines with a phosphorescent light in warm nights in the forests of Brazil. Though generally acrid, and more or less poisonous, some species are edible; *E. edulis* forms a pot-herb, its acidity being dissipated by boiling.

SPURGE-LAUREL. See DAPHNE.

SPURGEON, CHARLES HADDON, a great English Nonconformist preacher, was born at Kelvedon, Essex, 19th June, 1834, being the son and grandson of ministers of the Independent body. He went to a school at Colchester for some four years, and was afterwards at an educational institution at Maidstone. In 1849 he was appointed usher in a school at Newmarket, and soon after underwent the experience known as conversion. He now engaged in religious work at Cambridge and the neighbourhood, and became known locally as the 'boy preacher.' Having joined the Baptist body he accepted the pastorate of a small Baptist congregation at Waterbeach while he was only eighteen. His power as a preacher, young as he was, led to his being called in 1854 to the pastorate of the Baptist chapel in New Park Street, Southwark, which, becoming too small for his audience, required him to engage Exeter Hall, the Surrey Music Hall, and ultimately to build, in 1861, the great Metropolitan Tabernacle, which could accommodate 6000 persons. Here he preached and laboured for the rest of his life, his discourses

attracting hearers from all parts of the world. Besides his ordinary ministrations, and the publication since 1855 of a weekly sermon, he founded the Pastors' College, the Stockwell Orphanage, the Colportage Association, a Book Fund, Supplementary Pastors' Aid Fund, almshouses, schools, &c. In 1887 he severed his connection with the Baptist Union on what he called 'the down grade' tendency of a party in the church, against which he desired the union as a body to take action. He had for some years been tormented by rheumatism and gout, and had been laid up several times previous to his death, an event which took place at Mentone in the south of France, January 21st, 1892. Earnestness, simplicity, directness, liveliness, and not infrequently a genuine touch of humour were the chief characteristics of his sermons. Sagacity, common sense, straightforwardness, hatred for sham and falsity were prominent traits of his character as a man. He was the author of numerous volumes, among which the best-known are *The Saint and his Saviour* (1867), *John Ploughman's Talk* (1868), *Feathers for Arrows* (1870), *The Treasury of David*, a commentary on the Psalms extending to seven volumes (1865-80), *Types and Emblems* (1875), the *Metropolitan Tabernacle and its Work* (1876), *Farm Sermons* (1882), *The Present Truth* (1883), *Storm Signals* (1886), *Salt Cellars* (1889); and he edited the monthly magazine *Sword and Trowel*. His *Speeches at Home and Abroad*, edited by G. H. Pike, were published in 1878.

SPURN HEAD, a promontory of England, forming the most southern extremity of the coast of Yorkshire. It is a long narrow headland resembling a sickle, with its convexity outwards towards the German Ocean, and its concavity inwards towards the Humber. It consists of a long shingly and sandy beach, on which the sea used to make constant inroads, but this has been stopped by the construction of groynes. Two lighthouses have been erected upon it.

SPURRED RYE. See ERGOT.

SPURRFY (*Spergula*), a genus of plants of the natural order Caryophyllæ; though some botanists consider that it belongs to the Crassulacæ, and others to the Illecebracæ. It has a 5-parted calyx, 5 undivided petals, 5 or 10 stamens, 5 styles, 8-celled 5-valved, many-seeded capsule. This genus is found in fields and cultivated ground all over the globe. Corn-spurrey or Yarr (*S. arvensis*) is an annual found wild, commonly in sandy districts in Britain and the greater part of Europe. It has weak spreading stems, soft narrow leaves, inconspicuous white flowers, and is covered all over with clammy hairs. The flowers grow in loose bunches, consisting of twelve to twenty flowers. This plant is sometimes used in the sandy parts of Germany, Russia, Holland, and other northern parts of Europe, for obtaining a rapid crop of succulent herbage; a large variety (*S. maxima*), in damp, cloudy, or rainy climates, on sharp sands, will sometimes form a crop 3 feet deep; but in hot or dry places it rapidly runs to seed, and is worthless.

SPURZHEIM, JOHANN FRIEDRICH KASPAR, DR., a celebrated phrenologist, was born near Treves, in 1776, and received his medical education at Vienna, where he became acquainted with Dr. Gall, the founder of the system of phrenology. To this study Spurzheim became exceedingly partial; and he soon joined Dr. Gall in making inquiries into the anatomy of the brain. They quitted Vienna in 1805 to travel, and went in 1807 to Paris. From that period Dr. Spurzheim travelled and lectured in England, Scotland, and Ireland, and published *Physiognomical System of Drs. Gall and Spurzheim, &c.*; an *Examination of the Objections urged in England against the*

Doctrines of Gall and Spurzheim; Observations, &c. &c., on Mental Derangements; Philosophical Principles of Phrenology; Outlines of Phrenology, &c. In August, 1832, he visited the United States of America, and began his lectures in Boston, but death interrupted his labours on the 10th of November in the same year. See the article PHRENOLOGY.

SPY, in military affairs, a secret emissary sent into the enemy's territory or encampment to inspect their works, ascertain their strength or movements, and report thereon to the proper officer. The employment of spies by nations at war with each other is quite recognized by international law as interpreted by Grotius, Vattel, and Martens. 'Moses made use of such,' says the former, 'and Joshua himself acted in that capacity.' According to Vattel, if those whom a general employs make a voluntary tender of their services, or if they be neither subject to, nor in anywise connected with the enemy, he may unquestionably take advantage of their exertions without any violation of justice or honour. As the service is regarded as both dishonourable and dangerous, for it is the custom when a spy is caught to put him to an ignominious death, a general has no right to compel any person, whether a subject of his own or the enemy's country, to undertake it, and the only way a general can procure spies is by tempting rewards, which are generally made very high to secure the fidelity of the emissary. The proper business of a spy is to obtain intelligence, and he must not be employed to take the lives of any of the enemy. An officer or soldier found within the enemy's lines cannot be treated as a spy if he is clothed in his own uniform, but is dealt with either as a deserter or prisoner of war; but if wearing the enemy's uniform or civil dress, he is liable to be hanged. It is of course undeniable that this office cannot be performed without some degree of treachery, and a man of honour would generally refuse to act as a spy, yet under certain circumstances little moral guilt attaches to the performance of it. Alfred the Great's visit to the Danish camp in the guise of a bard, to gain information which led to his crowning victory, is not viewed as a disgraceful action; neither is the man who, even for hire, steals into the enemy's camp to obtain intelligence to be confounded with the infamous traitor who betrays his country for a bribe. In all cases, however, the offender, if captured, is liable by martial law to capital punishment. In the British army spies are under the control of the quartermaster-general; in the French of the chiefs of the staff. A cautious general should always carefully sift the reports given by spies, as these emissaries have frequently taken bribes from both parties for information of little or no value.

SQUAD, in the army, a small body of troops assembled for drill, inspection, or other purposes. A troop of cavalry or a company of infantry is usually divided into as many squads as there are sergeants or drill-instructors to train them. The awkward squad is composed of those recruits who have not received sufficient training to take part in regimental drill.

SQUADRON, the principal division of a cavalry regiment. The numerical strength of a squadron has varied at different periods; at present it ranges in the British army from about 120 to 200 men. This body is subdivided into two *troops*, each commanded by its captain, assisted by a lieutenant and a sub-lieutenant. Three or four squadrons form a regiment. When in line 1 yard in the length of the front is allotted for each man and horse; the space in line between every two squadrons is equal to one quarter of the extent occupied by each squadron. The strength of an army with respect to cavalry is

usually expressed by the number of squadrons in the field, as it is with respect to infantry by the number of battalions.—In the navy a squadron is a number of vessels employed on any particular service or station, under the command of a commodore or junior flag-officer.

SQUAMATA, the name frequently applied to the Serpents, Lizards, Tortoises, and Turtles conjointly, or those reptiles in which the body is covered with *scales* or scale-like plates. This term is used in contradistinction to the name *Loricata*—a group of reptiles represented by the crocodiles and alligators (forming the order Crocodilia), in which group bony plates or scutes are developed in addition to the horny plates or scales of the preceding group. See REPTILIA.

SQUARE, in geometry, a quadrilateral figure, both equilateral and equiangular, or, in other words, a figure with four equal sides and equal angles, which geometry proves must be right angles. It holds the first place among the parallelograms. The height and width of a square are equal: all squares are geometrically similar, and the diagonal line, or the line through two opposite angles, divides the square into two equal and similar triangles. On account of its perfect regularity, the square is of great importance both in pure and applied mathematics. In the measurement of surface it is the form to which all others are reduced. From the rule for calculating the superficial contents of parallelograms in general (to multiply the base by the perpendicular height), and from the nature of the square, it appears that it is only necessary to multiply one side by itself to have the area of the square, because each of the sides may be considered as the base or as the perpendicular height. Thus a square the sides of which measure 4 feet is equal to 16 square feet, that is, sixteen squares each 1 foot high and 1 foot long. The area of countries is generally given in square miles. Sometimes a great mistake is made by using square miles for miles square: 300 square miles is an area of 300 squares, each of which measures 1 mile in length and breadth, whilst 300 miles square is a square each side of which measures 300 miles—hence the whole square contains 90,000 square miles. To square a figure (for example, a polygon) is to reduce the surface to a square by mathematical means. It has often been attempted to square the circle, but this cannot be done. (See CIRCLE.) To obtain the square of a number, the number is multiplied by itself; and to extract the square root of a number is to find that magnitude which, multiplied by itself, gives the magnitude from which we have to extract the root. See ROOT.

SQUARE, in military tactics, is the figure formed by infantry to resist most effectually an attack of cavalry in the open field. It can be formed in different ways, and it was once customary to spend much time in drilling troops to execute all the varieties of squares and other figures having the same object; but experience has shown that the so-called solid square is the best, on account of its movability and simplicity, as well as its power of resistance, though it is perhaps more exposed to the effects of artillery. The hollow square was much used by the British at Waterloo. A column being of a square shape, can be thrown into a solid square immediately by making the men face to each of the four sides. If a solid square is broken, the parts again form squares by facing to the four sides.

SQUARE, MAGIC. See MAGIC SQUARE.

SQUARE-RIGGED vessels are such as do not have their sails extended by stays, lateen, or lug-sail yards, or by gaffs and booms, the usual situation of which is nearly in a plane with the keel.

**SQUARE ROOT.** See **ROOT**.

**SQUARE-SAIL** is any sail extended to a yard suspended by the middle, and hanging parallel to the horizon, as distinguished from sails extended obliquely.

**SQUASH** (*Cucurbita melopepo*), a variety of the Gourd family. (See **GOURD**.) It has a large fruit, reddish, yellow, or yellowish-white within and without; of a round form, but often flattened at top and at bottom; occasionally warted. It is cultivated in America as an article of food, and is of great use in long voyages, as it keeps fresh for months, and may be made into pies like the pumpkin, or boiled and eaten with meat as a substitute for potatoes or turnips.

**SQUATTERS** are persons who settle on public or new lands without any title. In Australia the sheep-farmers, who occupy the unsettled tracts of land as sheep-runs under lease from government at a nominal rent, are also called squatters.

**SQUID**, the popular name given to certain cuttle-fishes belonging to the Dibranchiate (or 'two-gilled') group of the class Cephalopoda, and included in several genera, of which the most familiar is that of the Calamaries (*Loligo*). The family Teuthidae, indeed, may be regarded as including the squids in greater part; this family being distinguished by the elongated body, terminating by expansive fins; by the horny 'pen,' representing the internal shell of these forms, and which consists of a median shaft, with two lateral wings or projections. The fourth left arm in the males of the Common Squid (*Loligo vulgaris*) is modified to form a *hectocotylus* or male reproductive organ. The last-mentioned form is one of the most familiar of British cuttle-fishes. It is frequently cast up on the shores after storms, and may attain a length of from 12 to 18 inches. Its body exhibits generally a ruddy or pinkish hue, but it can alter its colour at will. The Little Squid (*Sepiola Atlantica*) is sometimes cast on the shores, and is of smaller size than the Common *Loligo*. The Flying Squids, belonging to the genus *Ommastrephes*, are so named from their habit of leaping from the sea, sometimes to such a height as to land them upon the decks of vessels; whilst other forms belong to the genus *Onychoteuthis*, the species of this latter genus having the suckers on their tentacles armed with claws. The squids are all of them *Decapodous* or 'ten-armed' cuttle-fishes, two of these arms or tentacles being elongated beyond the remaining eight, and possessing suckers at their extremities only. The suckers are in addition *pedunculated*, that is, borne on short stalks; and an ink-sac or ink-bag is also developed in these forms. They are, like other cuttle-fishes, able to propel themselves swiftly over the surface of the sea by means of *jets d'eau* from the 'funnel' situated in front of the body, the water ejected therefrom consisting of that which has been used in the breathing or respiration of the animals.

**SQUILL.** The official squill (*Scilla maritima*) belongs to the natural order Liliaceae. It has six stamens and a single style; the calyx is wanting, and the corolla is deeply divided into six segments; the bulb is large, and similar in form and structure to that of the onion; the stem upright, cylindrical, terminated by a long raceme of white flowers; the leaves appear after the flowers, and are all radical, very large, oval-lanceolate, and fleshy. It grows on the sandy coasts of the Mediterranean. The bulb has a nauseous, bitter, and acrid taste, but is destitute of any perceptible odour. It is poisonous to several animals, and if much handled produces ulcers on the skin. In large doses it occasions vomiting, strangury, inflammation of the stomach and bowels, &c.; but in small doses acts simply as an expectorant and

diuretic. It has been much esteemed from antiquity, and its various preparations are still used in medicine.

**SQUILLA.** See **SHRIMP**.

**SQUINTING**, or **STRABISMUS** (from *L. strabo*, a squint-eyed person), a non-coincidence of the optic axes of the eyes upon an object, occasioned by a permanent lengthening of one of the lateral muscles of the ball of the eye, and a permanent shortening of its antagonist. This disorder may often be to a great extent overcome, especially in children, by blindfolding the sound eye, presuming one only to be affected. In very bad cases, especially those of squinting inwards, the deformity may be greatly relieved by a well-known surgical operation, which consists in dividing the shortened muscle of the eyeball. This is done by proper scissors without externally wounding the eyelid.

**SQUIRREL** (*Sciurus*, see plate at **RODENTIA**, fig. 1, 2), a genus of Rodentia, forming the type of several distinct genera of the Scuriidae or Squirrel family. This family is distinguished by the incisors—largely developed, as in all Rodents—being smooth in front and orange-coloured. The molars are of complicated structure, and number ten in the upper and eight in the lower jaw. The fore-feet have the thumbs rudimentary. No cheek-pouches exist in the true Squirrels, and the tail is of hairy or bushy nature. The genera *Sciurus* (including the ordinary Squirrels), *Pteromys* and *Sciuropterus* (including the species of Flying Squirrels), and *Tamias*, or that represented by the Ground Squirrels, are the chief divisions of this family. The Common Squirrel (*Sciurus Europæus*), the Gray Squirrel of North America (*S. cinereus*), the Long-eared Squirrel (*S. macrotis*), and the Black Squirrel (*S. niger*) are all well-known species of true Squirrels. No British animal is so well known, either as to its appearance or habits, as the Common Squirrel. Its active arboreal habits and sprightly appearance have done much to make the Squirrel the admitted type of frolicsomeness and sport. The colour of the fur is usually a rich ruddy brown on the upper parts, this colour merging into reddish or grayish white on the under portion of the body. The fur is liable to much variation in different seasons and climates, and in winter the coat may exhibit a general and somewhat unusually gray appearance. The food consists of nuts, acorns, seeds, &c., and these animals evince economic and frugal habits, the reputation for which made the ants so famous, in that they accumulate during the autumn a store of provisions, which is deposited in the nooks and crannies of trees. The nest and dwelling-place consists of a spherical structure formed of intertwined woody fibres, leaves, and moss, and is generally placed in the fork of a bough, and in an inaccessible situation so far as other animals are concerned. The Squirrels exhibit a great attachment for their respective nests, one pair generally occupying the same tree and nest for a lengthened period. From three to four young are produced at a birth, usually in June, the young remaining in the parent nest until the following spring. When engaged in eating, these animals grasp the nut or other food in their fore-paws, sitting meanwhile on their haunches, and gnawing off, by aid of their powerful teeth, the hard outer coverings, and even peeling the kernel before eating it. The bushy tail of the Squirrel, besides serving, when folded round the body, to retain the heat, assists through its outspread hairs in supporting the animal in its aerial flights, a function subserved in other Squirrels by special developments of the skin. North America being unquestionably the great area of distribution of these animals, we are prepared to find numerous and typical species included among the fauna of that continent. The Black Squirrel is

a typical North American species, but appears to be rather local in its distribution. The fur, as indicated by the name, is of a deep sable hue. The length of this form is about 2 feet 10 inches, of this measurement the tail making about 18 inches, whilst its fur is exceedingly thick and bushy. The Red Squirrel (*Sciurus Hudsonius*) is another familiar American species, which is very common in the Northern States. The ears are distinctly tufted; the colour is reddish-brown above, pale beneath, with a pretty distinct black line on each flank. It is smaller than the Gray Squirrel. The Gray Squirrel, already mentioned, is also well known in the New World. It is sometimes known as the Cat-squirrel, and is distinguished by its size and by the fur being less coarse in its texture. The length of the body is 12 inches, and of the tail 14; the colour cinereous above and white beneath; the tail is less distichous than in the others, and striped with black. Another species is the Fox-squirrel (*S. rufinus*), which inhabits exclusively the pine forests of the Southern States of America, and is a large species. The body is 14 inches in length, and the tail 16. The colour is gray and black, or mottled, &c. *S. capistratus* is a variety having the nose white. A species, sometimes also known as the Gray Squirrel (*S. Carolinensis*), is very common in most parts of the United States, especially in oak, hickory, and chestnut forests. Formerly it was so abundant in many districts as to become a scourge to the inhabitants. It is remarkable for its beauty and activity, and when kept in confinement is exceedingly playful and mischievous. It is much smaller than the two preceding; the colour is usually fine bluish gray mixed with a slight tinge of orange, and the tail is edged with white. The three foregoing species often occur entirely black, and in this state have been described as distinct species. *S. quadrivittatus* is a very small species, inhabiting the vicinity of the Rocky Mountains about the head-waters of the Platte and Arkansas. The general colour is reddish above, mixed with black, and whitish beneath, with four broad white lines on the back. It has not been observed to ascend trees, but nestles in holes or on the edges of rocks, and the nest is composed of a most extraordinary quantity of different vegetable substances, sometimes sufficient to fill a cart. Its principal food seems to consist of the seeds of the pine. The Great-tailed Squirrel (*S. macrurus*) is the most common species on the Missouri. It is a large species, of a ferruginous colour, and has the tail larger than the others. Of Asiatic species a familiar form is the Long-eared Squirrel, already mentioned, which occurs in Borneo, and which derives its name from the extreme length of the tufts of hairs belonging to the ears, which are themselves of ordinary size. The ear-tufts are about 2 inches in length, of blackish-brown colour and erect structure. The back and outer aspect of the limbs is of a rich chestnut-brown hue, which on the flanks assumes a paler tint, and exhibits a dark longitudinal stripe running from the fore to the hind limbs. The inner aspect of the limbs is of a pale chestnut colour, the paws being black. The tail is very large and bushy, and has its darker hues relieved by lightish-coloured hairs. The average length of this squirrel is about 2 feet, the tail making up about half of this measurement. Another species, the Javan Squirrel or Jelerang (*Sciurus bicolor* or *Jara*), is found in Java, Cochinchina, and India.

It may be noted that in some instances Squirrels have proved themselves great destroyers of cultivated crops. In the United States of America, for example, during the 18th century, one species (*Sciurus migratorius*) caused immense loss in the state of Pennsyl-

vania; and owing to a reward of 8d., which was offered for each squirrel that was killed, 640,000 of these animals, representing a total sum of £8000, were killed in 1749.

The genus *Tamias* includes the Ground or Earth Squirrels, which are distinguished from the true Squirrels by possessing *cheek-pouches*, or cavities in which food may be temporarily stowed away. The feet are shorter than those of the true Squirrels, and the tail is shorter than the body. The species of this genus inhabit North America, and the Hackee or Chipping Squirrel (*T. lysteri*) is a familiar species. It attains a length of about 11 inches, the tail being 4 inches long. Its colour is a brownish gray on the upper parts, lightened with orange or light brown on the forehead and hind-quarters. The back and sides are striped longitudinally with black and yellowish markings, and the throat and belly are white. These animals inhabit shallow burrows, which they excavate in quiet situations. The nest exists at the extremity of the burrow, which is often long and tortuous, and in the nests these squirrels remain in a state of torpor during the winter months. The food consists of nuts, grains of corn, seeds, &c. The young, which are produced in May, number four or five, and a second litter may be born in the following August. The stoat (which see) is a decided enemy of this squirrel, and frequently makes inroads upon the burrows, killing the inhabitants and devastating their abodes.

The genus *Pteromys* includes several species of 'Flying' Squirrels. This genus is distinguished by the skin of the body being extended along the sides, in the form of a *patagium* (which see) or flying membrane, and between the fore and hind limbs. This skin-membrane acts as a kind of *parachute* in supporting these animals in their leaps from tree to tree, but its possession does not confer upon these forms, as will readily be seen, any true powers of flight. The *Pteromys pteraurista* or Taguan Flying Squirrel, inhabiting India, is a good example of this genus. The average length of this form is about 3 feet, inclusive of the tail, which measures about 20 inches. The patagium is well developed in this form, and is of thin structure, being chestnut on its upper and white on the under surface. The back is dark brown, the general body-colour being a chestnut, whilst the tail exhibits hues varying from grayish-black to a very dark hue. The patagium is edged with gray. The nearly-allied genus *Sciuropterus* also includes forms known as Flying Squirrels. In this genus a patagium is also developed; the tail is short and flattened, and the molar teeth are tuberculate in structure. These forms inhabit India, Polynesia, North-eastern Europe, Siberia, and North America. The *Sciuropterus volucella*, or Assapan of America, is a familiar species.

Amongst animals which receive the name of Squirrels, but which have no relationship with the Rodents just described, may be mentioned the Sugar or Petaurus Squirrel (*Petaurus Sciurus*), a Marsupial Mammal, included among the Flying Phalangiers (which see), and also possessing a patagium or flying membrane. The tail is not prehensile in this form, this species averaging 16 inches in length, the tail, measuring 8 inches, being included. These animals occur in Australia and New Guinea.

SQUIRREL-MONKEY, the name given to certain Platyrrhine Monkeys belonging to the genus *Callithrix*. This genus is distinguished by the straight incisor or front teeth, and by the short canines. The tail is slender and rounded. These monkeys inhabit Brazil, and derive their popular name from their resemblance in general appearance and size to the familiar squirrels. A well-known species is the *C. Sciureus*

or Salmiri, which is coloured grayish olive, the under surface being gray; the ears white, and the tail tipped with black. The Collared Callithrix (*C. torquatus*) is distinguished by possessing a dark band of colour around the neck. These monkeys are of an intelligent disposition and of amiable temper. They may exhibit great attachment to their keepers, and are highly appreciative of kindness and gentle treatment.

SRINAGAR, SERINAGUR, or CASHMERE, the capital of Cashmere, chiefly on the right bank, but partly also on the left bank of the Jhilam, here about 100 yards wide, crossed by seven rustic wooden bridges, upwards of 5000 feet above sea-level. It extends about 2 miles along the river, which, with its windings, and the numerous vessels plying upon it, has a very picturesque appearance; is surrounded by walls and ramparts of no great strength, and defended by an ill-constructed fort, situated on a height so commanding that it might easily be made impregnable; and consists for the most part of a mere labyrinth of narrow dirty lanes and very indifferent houses of unburned bricks and timber, generally of two or three stories, but often dilapidated and almost ruinous. Some detached houses of a better class, surrounded by a wall and gardens, communicate by a canal with a beautiful lake immediately east of the town. Few of the public buildings deserve much notice. One of the oldest is a tomb of an octagonal form, built of brick, with walls from 7 feet to 8 feet thick, and surmounted by a dome deficient in beauty but remarkable for strength and solidity. A more celebrated edifice is the Jama Masjid or great mosque, of such extraordinary dimensions that the natives represent it as capable of containing 60,000 persons. It is built of stone below and brick above, is surrounded and partly supported by massive wooden pillars, and terminates in a rude dome and spire, also wooden. Another mosque, entirely of timber, is in a very singular style of architecture, somewhat resembling the Chinese. Srinagar has manufactures of shawls, paper, leather, firearms, otto of roses, &c. Pop. in 1891, 118,460; in 1901, 122,618.

STABAT MATER, a celebrated Latin Church song, in terzines, which is sung in the Catholic Church, particularly on the festival of the Seven Sorrows of Mary, and generally during the services in Lent. Some consider one of the popes (John XXII. or one of the Gregories) as its author; but, according to the most probable opinion, it was written by the Minorite Jacobus de Benedictis, generally called Jacopone di Todi, who lived in the thirteenth century, a learned jurist, whom the death of his wife induced to enter, in 1268, the order of St. Francis, and to give himself up to the severest penances, which terminated in insanity. He died in 1306. The words have received several changes. The best composers of church music have employed their talents upon it. The best compositions are those of Palestrina (for eight voices), written on his death-bed, of Pergolesi (for two voices, with an accompaniment), and Astorga. Among the later composers of this beautiful piece are Haydn, Rossini, and Dvofak. The Stabat Mater is one of those Latin hymns of the early church which breathe a truly poetical and sacred enthusiasm. We give it at length, as we have done the Dies Iræ.

Stabat mater dolorosa,  
Juxta crucem lacrymosa,  
Dum pendebat filius;  
Cujus animam gementem,  
Contristatam et dolentem  
Pertransiit gladius.

O! quam tristis et afflicta  
Fuit illa benedicta  
Mater Unigeniti.

Quæ moriebat et dolebat  
Et tremebat, cum videbat  
Nati poenas inolyti.

Quis est homo qui non fletet  
Christi matrem si videret,  
In tanto supplicio?  
Quis posset non contristari,  
Piam matrem contemplant?  
Dolentem cum filio.

Pro peccatis sue gentis  
Videt Jesum in tormentis,  
Et flagellis subditum;  
Vidit suum dulcem natum  
Morientem, desolatum,  
Dum emisit spiritum.

Eia mater, fons amoris!  
Me sentire vim doloris  
Fac, ut tecum lugeam.  
Fac ut ardeat cor meum  
In amando Christum Deum  
Ut illi complaceam.

Sancta mater! istud agas,  
Crucifixi fuge plagas,  
Cordi meo valide.  
Tui nati vulnerati,  
Tam dignati pro me pati,  
Poenas necum divide.

Fac me vere tecum flere,  
Crucifixo condolere,  
Donec ego vixero.  
Juxta crucem tecum stare,  
Te libenter sociare,  
In planctu desidero.

Virgo virginum præclara!  
Mihî jam non sis amara,  
Fac me tecum plangere;  
Faci ut portem Christi mortem,  
Passionis ejus sortem,  
Et plagas recolare.

Fac me plagis vulnerari,  
Cruce hac inebriari,  
Ob amorem filii.  
Inflammatum et accensum,  
Per te, virgo! sim defensus  
In die judicii.

Fac me cruce custodiri,  
Morte Christi præmuniri,  
Confoveri gratia.  
Quando corpus morietur,  
Faci ut anima donetur  
Paradiſi gloria.

STABILITY, ability to stand. Equilibrium is described as of three kinds, having reference to the position of the centre of gravity of a body—viz., stable, unstable, and neutral. Stability is said to be secured when, if in overturning a body round any of its points of support, its centre of gravity will be raised during the first part of the motion. A point may be noticed in connection with the stability of structures, such as tall chimneys or steeples. Suppose two chimneys of exactly the same proportions, but that one is twice as large in every dimension as the other; the force tending to overturn these chimneys is the wind. The force of the wind is proportional to the surface, and is four times as much in the large chimney as in the small one; but the resisting force is proportional to the weight, which is eight times as great for the large chimney as for the small. When we keep sufficiently within the limit of weight at which the material would crush, stability, such as we have illustrated by the case of the two chimneys, appears to increase in the ratio of the cube to the square of the fraction made by dividing a linear dimension of the larger by the corresponding dimension of the smaller in proportional structures. One of the most marked characteristics of Gothic architecture is the skill with which large structures, built of comparatively small stones, have been designed so that there is no misplaced weight.

STACCATO. See MUSIC, page 383, with example.

**STADE**, a town of Prussia, in the province of Hanover, capital of a district of same name, on the Schwinge, about 4 miles above its confluence with the Elbe, 21 miles west of Hamburg. It is a place of some antiquity, has several churches, a gymnasium, normal seminary, house of correction, &c., and possesses some shipping and trade. Pop. (1895), 10,058.—The Stade dues (Stader Elbzoll) were a toll charged on all cargoes shipped to Hamburg. Up till 1691 these dues could not be considered extortionate, but they were gradually increased by the Hanoverian government till they brought in a revenue of £40,000; the cargoes being taxed  $\frac{1}{4}$  per cent. ad valorem. This obnoxious toll was at last taken off in 1861, Hanover receiving an annual compensation of £30,000, one third of which was contributed by Great Britain, another by Hamburg, and the remaining third conjointly by Denmark, the Netherlands, Hanover itself, France, Sweden, and other countries trading to the Elbe.

**STADIUM**, a Greek measure of length, equal to 600 Greek or 625 Roman feet; that is, it contained 606 feet 9 inches English measurement. This standard prevailed throughout Greece, and was called the Olympic Stadium, as it was the exact length of the stadium or foot-race course at Olympia, measured between the pillars at each end of the course. A day's journey by land was reckoned at 200 or 180 stadia, or for an army 150 stadia. The stadium at Olympia was used not only for the foot-race, but also for all the other contests which were gradually added to the games, except the horse-races, which took place in the hippodrome, similar in shape to the stadium, but larger. The name stadium was also applied to all other places throughout Greece wherever games were celebrated. The stadium was an oblong area terminated at one end by a straight line, at the other by a semicircle, the breadth of the stadium forming its base. Round this area, the rows of seats rising above each other stepwise, were placed for the spectators.

**STADTHOLDER** (Dutch *stadhouder*, lieutenant), in the republic of the United Netherlands, the commander-in-chief of the military forces. The title was derived from the period when Spain and Burgundy had dominion in that country. The United Netherlands were then under a governor-general, and the separate provinces had particular governors. Soon after several of the towns of Holland had revolted against the tyranny of the Duke of Alva, the lieutenant of Philip, king of Spain, they chose for their governor William, prince of Orange, swearing allegiance to him as the king's stadtholder, thus implying that it was against the duke and not against their king they had revolted. In 1581 the authority of Philip was entirely shaken off, and the provinces of Holland and Zealand were on the point of formally investing William of Orange with the supreme authority, when he was assassinated in 1584. The states-general then declared the Earl of Leicester (who was sent with a body of troops by Elizabeth, queen of England, to aid them against the Spaniards) stadtholder. The states of Holland and Zealand, however, had conferred the government of their provinces on Prince Maurice, second son of the murdered Prince of Orange; and he was the first stadtholder who had been appointed by the separate provinces. When Leicester resigned the stadtholderate, Maurice was chosen, in 1590, stadtholder of Guelders, Utrecht, and Overijssel. He was succeeded by his brother Frederick Henry and his son William II. in the government of the five above-mentioned provinces. William Louis, count of Nassau, a son of the Count of Nassau-Dillenburg, the younger brother of William I., was stadtholder

of Friesland, and afterwards of Groningen. He was succeeded in Friesland, after his death, by his brother Ernest Casimir, count of Nassau-Diets; but Groningen, and the province of Drenthe, elected Prince Maurice, so that he was now governor of six provinces. After his decease, Count Ernest Casimir was also elected by Groningen and Drenthe. The next stadtholder in Friesland and Groningen was his son Henry Casimir; and after his decease, Frederick Henry, prince of Orange, attempted to unite the stadtholderate of these provinces with that of Holland, Zealand, Utrecht, Overijssel, and Guelders, which he already enjoyed. But he only acquired Groningen, to which his son William II. succeeded. In Friesland, William Frederick, brother of Count Henry Casimir, was made stadtholder; and, on the early death of William II., prince of Orange, he was likewise elected stadtholder of Groningen. The government of both these provinces thenceforward devolved on the male posterity of William Frederick. In the five remaining provinces—Guelders, Holland, Zealand, Utrecht, and Overijssel—after the death of William II., the stadtholderate ceased. By his disputes with the states of Holland he had made himself many enemies; and, by the artifices of John de Witt, grand pensionary of Holland, his son William III. was excluded from the stadtholderate by the act of exclusion agreed to by the province of Holland, in a treaty with Cromwell in 1654, and in 1667 by the *perpetual edict*, as it was called. But, in 1672, when Louis XIV. attacked the United Netherlands, the magistrates of the Dutch cities were forced, by popular insurrections, to repeal the perpetual edict, and to declare William III., prince of Orange, stadtholder. The same scene was acted over again in Zealand, Guelders, Utrecht, and Overijssel; and in these five provinces the stadtholdership was declared to be hereditary in the male line of William III. He retained his authority after he was made king of England, in 1688. But, as he died without children in 1702, the place was vacant for many years. In 1722 William Charles Henry Friso (a son of John William Friso, prince of Nassau and Orange, and stadtholder of Friesland and Groningen) was elected stadtholder by the province of Guelders. Holland, Zealand, Utrecht and Overijssel retained their former government till 1747, when France invaded the lands of the generality. The states of Zealand and Holland were now compelled, by a general insurrection, to appoint the above-named prince, William Charles Henry Friso, stadtholder, and Friesland and Overijssel soon followed the example. William IV. was thus the first stadtholder of all the seven provinces. The dignity was declared hereditary both in the male and female lines; but kings and electors, and all persons out of the pale of the Reformed Church, were excluded, whether male or female. In case the stadtholderate should devolve upon a minor, the mother was to preside, under the title of *governess*, as long as she remained a widow and a resident of the states; and, in case of war, she was to have the privilege of nominating a general to the states. If the mother were absent, or not living, the states were to have the right of electing a guardian. On the death of William IV. he was succeeded by his son William V., then three years old, under the guardianship of his mother, a daughter of George II. of England, who, on the day of her husband's death, assumed the office of governess. She died in 1759, and Louis, prince of Brunswick, who had been from 1750 field-marshal-general in the Dutch service, was chosen guardian of the young prince; and, in 1766, at the age of eighteen years, William took upon himself the discharge of his office.

The authority of the stadtholder was not the same

in all the provinces; for he was appointed by each province separately, and received from them more or fewer privileges. With the general stadtholderate was connected the dignity of captain-general and admiral of the state; and his authority consisted in the exercise of sundry high privileges with regard to the affairs of government and the military and naval forces. He presided, by virtue of his office, over the states-general and provincial assemblies, and had an important influence on the legislation. As captain-general, he was commander-in-chief of the troops, but he could not undertake any campaign, or other military enterprise, without the consent of the states-general, and they often sent commissioners to the army, whose assent was requisite to every movement. As high-admiral he commanded the naval force of the state. The power of the stadtholder in many respects amounted to sovereignty, and was made still greater in 1747 by the institution of the general hereditary stadtholdership. In the war between France and Britain in 1778, in which the republic of the Netherlands became involved, the people grew dissatisfied with William V., and stripped him of his authority in the Hague, suspending him also from his office as captain-general. Having married a niece of Frederick the Great, however, he recovered the rights and privileges which had been taken from him by the aid of Prussian troops. In 1788 the stadtholderate, with all its rights, was declared to be an essential part of the government of each province and of the whole republic of the Netherlands. The stadtholder took advantage to the utmost of the power thus put into his hands, and declared the brightest ornaments of the opposite party, the *patriots* (so called), incapable of holding any office. These measures induced many to leave the country, and filled those that remained with dissatisfaction. At the period of the revolution, France profited by this state of things. It declared war, not against the republic, but against the stadtholder; and, in 1794, after a slight resistance, Holland was occupied by the French under Pichegru, and the hereditary dignity of general stadtholder was abolished for ever. By the decree of the imperial deputation in 1803, the hereditary stadtholder received indemnification in Germany; but, by the war of 1806 and 1807, he lost it again, and lived as a private man till 1813, when he was recalled, and by a decree of the congress of Vienna received the title of king. See NETHERLANDS.

STAËL-HOLSTEIN, ANNE LOUISE GERMAINE NECKER, BARONNESS DE, a celebrated French authoress, was born at Paris, 22d April, 1766. She was the only child of Necker, the eminent Swiss banker, and afterwards minister of finance to Louis XVI. Her early education under the direction of her mother, a woman of a pedantic and puritanical character, was severe and systematic. The inflexible discipline of her mother was, however, fortunately counteracted by the indulgent tenderness of her father, for whom she then and ever cherished an extreme affection and a respect bordering upon idolatry. Necker's house was the resort of the most distinguished men of the capital; every week on a certain day were assembled in the *salon* of Madame Necker the most eminent scholars of the day, as Marmontel, Raynal, Grimm, Thomas, &c. The encouragement to converse which the young girl received in this society, and the various excitements which it furnished to her faculties, had an important influence on the formation of her mind. To these she owed that rare conversational power for which she was so remarkable, with an inclination to ingenious, brilliant, and striking theories, which appears in her earlier works. When her father's *Compte-rendu* was published in 1781 she wrote him

an anonymous letter on the subject, which he recognized by the style of thought to be hers. In her fifteenth year she made abstracts from Montesquieu's *Spirit of Laws*, accompanied with remarks; and at this time Raynal wished to insert in his *Histoire des deux Indes* some pages she had written on the revocation of the edict of Nantes. Her earliest productions were *Sophia*, a comedy, written in 1786, and two tragedies, *Lady Jane Grey* and *Montmorency*. Her *Lettres sur les Ouvrages et le Caractère de J. J. Rousseau*, which were printed in 1788, first attracted the public notice. In 1786 she was married to the Baron de Staël-Holstein, Swedish ambassador at the French court, a man much older than herself, whose suit was favoured by Madame Necker's desire that her daughter should marry a Protestant.

The breaking out of the revolution (1789) necessarily exercised a powerful influence both on her mind and fate. The first period of her father's service in the ministry (1777-81) brought his family into connection with the great world and public affairs. Her father's banishment in 1787, and his triumphant return in 1788, deeply affected her; at last the storm became too fierce for him, and he was obliged to retire from public life. During Robespierre's ascendancy she exerted herself to save the victims, and published a powerful and eloquent *Defence of the Queen*. After the insurrection of August 10, she delayed her departure from day to day, unwilling to provide merely for her own safety while so many of her friends were in danger. On September 2 she attempted to leave Paris, and escaped the popular fury only by rare good fortune. She arrived safely at her father's house at Coppet in Switzerland, which now became the refuge of the unhappy fugitives from the tyranny which preyed upon France. When Sweden recognized the French republic, her husband was again sent as ambassador to Paris, whither she also returned in 1795. The quiet which was restored with the government of the directory gave her an opportunity of effecting the recall of some of the emigrants. Barras became her friend; and she acquired so much influence that, on Talleyrand's return from America in 1796, she obtained, through Barras, his appointment to the ministry of foreign affairs. To this period also belong two political pamphlets, *Sur la Paix* and *Sur la Paix intérieure*, which contain her views respecting the situation of France in 1795, and express the remarkable opinion that France could arrive at limited monarchy only through military despotism. In 1796 appeared her work *De l'Influence des Passions sur le Bonheur des Individus et des Nations*, which, though characterized by deep thought and enlightened views, does not contain any complete exposition of the subject.

Her connection with her husband, whose tastes were different, and whose talents were inferior to her own, had been from the first marked by coldness; and when she became desirous of securing the property of their children from the effects of his lavish habits, a separation took place; but his infirmities rendering the services of his friends necessary to him, she again joined him. He died in 1802, while on the way, in company with her, to her father's residence. The man who exercised so fatal an influence upon the rest of her life—Bonaparte—she had seen for the first time in 1797, on his return to Paris, after the peace of Campo-Formio. His brilliant reputation excited her admiration, but this sentiment soon gave way to fear and aversion. The danger which threatened Switzerland led her back to Coppet; but when Geneva was incorporated with France she hastened back to Paris, to cause her father's name to be struck from the list of emigrants.

Bonaparte visited Necker before his passage over the Great St. Bernard, and made a favourable impression upon him during a long interview, in which he spoke of his future plans. But some observations of Necker in his *Dernières Vues de Politique et des Finances* (1802) offended the first consul, who had no wish to see his plans prematurely announced, and therefore caused the work to be attacked in the journals. By his direction the Consul Lebrun wrote a sharp letter to Necker, advising him not to meddle any more with public affairs.

Madame de Staël was banished to a distance of 40 leagues from Paris, under pretence that she had given her father false information of the state of France. During her banishment she lived with her father at Coppet, but spent much time in travelling. Her literary reputation was meanwhile increased by her *De la Littérature considérée dans ses Rapports avec les Institutions sociales* (two vols. Paris, 1802), and her *Delphine* (1802). The former work attracted many assailants, among whom Fontanes was the ablest and acutest. She had, indeed, overestimated the influence of literature upon the character and happiness of men, and pronounced too confidently upon its history and prospects. Her romance *Delphine* contained a faithful picture of herself as she was in her youth—a creature separated from the multitude by genius and sensibility, and struggling against the restraints of custom and her sex. Mad. de Staël found herself obliged to defend the moral tendency of *Delphine*, but did not succeed. In 1803 she made a visit to Germany, and lived for about a year in Weimar and Berlin, when her father's sickness recalled her to Switzerland, but he died before she reached home. His death rendered her religious feelings more lively, and in this state of mind she wrote an account of his domestic life (prefixed to the *Manuscrits de M. Necker publiés par sa Fille*, 1805). Mad. de Staël paid a visit to Italy in 1805. The fruit of her journey to Italy was *Corinne ou l'Italie* (1807), which combines in a happy manner the charms of romance with a faithful picture of Italy. Her *Corinne* was finished in France, and no sooner was it published than she was ordered to quit this country, upon which she returned to Coppet, then passed the winter of 1807–8 at Vienna, and returned to Coppet again. Here she wrote *Essais dramatiques*, and finished (1809) her work on Germany (*De l'Allemagne*). She then went to France to get it printed, but before it could be published the printed copies were seized by the police, and she was ordered to quit France. It first appeared entire at London in 1813. This work has been justly criticized as containing many erroneous views, but it gave the French the first intimation of the intellectual development of Germany.

Returning to Coppet from France, Mad. de Staël was subjected to new persecutions, and was forbidden to go farther from her residence than 2 leagues. But in the spring of 1812 she escaped, and passing through Vienna to Moscow, on the approach of the French army went to St. Petersburg, and soon after, in the autumn of 1812, to Stockholm. From Stockholm she went to England, where she was received with the most flattering attention. Here, as already mentioned, was published her work on Germany, as well as her *Réflexions sur le Suicide, and Zulma et trois Nouvelles*. After a long exile, the sufferings of which she has described in her *Dix Années d'Exil*, she landed at Calais in 1814. On the return of Napoleon in 1815 she retired to Coppet; but when Louis XVIII. again took his seat on the throne she returned to Paris, and was received with great distinction. After the restoration she received from the government public stock to the amount of 2,000,000 fr., due to her father by the treasury at the time of his dis-

missal from office. Surrounded by a happy domestic circle, esteemed and courted by the most eminent men of the capital, she lived in Paris, with the exception of a short absence, till her death. Until her last sickness she was employed on her *Mémoires et Considérations sur les principaux Evénements de la Révolution Française* (Paris, 1819, three vols.) The completion of this work was interrupted by her death, which took place 14th July, 1817. By her will it was made known that in 1812 she had been married a second time to a M. de Rocca, a young officer of huzzars, who, suffering from wounds received in Spain, had quitted the service, and come to reside at Geneva, where she became acquainted with him.

STAFF (from the staff formerly borne by officers in high command), in military affairs, means generally the officers whose command extends over several bodies of troops, of which each has its particular officers. The following is the staff of the British army:—The commander-in-chief, his aides-de-camp, private secretary, military secretary, and assistants; the adjutant-general of the forces, together with the deputy, assistant, and deputy-assistant adjutants-general; the inspector-general of recruiting; the adjutants-general of the artillery and engineers, with the assistant and deputy-assistant adjutants-general; the quartermaster-general, his assistant and deputy-assistant; the deputy-quartermaster in the intelligence department, and his assistant; the director of the topographical branch and his assistants; the director-general of military education and his secretary; the inspector-general of artillery and his aide-de-camp; the inspector-general of auxiliary forces and the assistant adjutant-general; the chaplain-general; the director-general of the medical department, the surgeon-general, and deputy surgeons-general. The members of the personal staff (the aides-de-camp and military secretaries of the respective general officers) are generally appointed by the generals whom they serve, and their appointments expire when those generals cease to command. Officers for the staff (exclusive of the personal staff) must either pass through the staff college or undergo the final examination set for particular department, except those who have proved their competence for the post by having already acted as staff-officers with troops in the field. Officers of the engineers are also exempted from these rules. Each regiment has besides a staff of its own, consisting of the adjutant, quartermaster, and their assistants or military secretaries.

STAFF, in music, the five parallel lines, and their intermediate spaces on which the notes, sharps, flats, and other musical characters are placed. See MUSIC.

STAFF, BISHOP'S. See CROSIER.

STAFFA, a small island of the Hebrides, belonging to Argyleshire, celebrated for its basaltic pillars and its natural caverns, particularly the cave of Fingal, 7 miles north of Iona, 5 west of Mull. It is of an oval form,  $1\frac{1}{2}$  mile in circuit, presenting an uneven table-land, terminating nearly all round by cliffs of variable height. The island is composed of a fundamental ledge of rocks of conglomerated trap or tufa, to which succeeds a grayish-black, hard, and compact columnar basalt, which again is covered by a mass of shapeless basalt, with small columns interspersed through it. The cliffs and the arches and floorings of the caves strongly resemble architectural designs, and have been described in terms proper to works of art. The greatest elevation is 144 feet. The surface is covered by a rich soil and luxuriant grass, affording excellent pasture for a herd of black cattle; but there is no house on the island. A considerable portion of the precipitous face of Staffa is in a columnar form; the highest point of this face is

112 feet above high-water mark. The coast is indented with numerous romantic caverns, of which the most remarkable is Fingal's, or the Great Cave, the opening into which is a magnificent archway, 66 feet high at mean tide, supporting a massive entablature of 30 feet additional, and receding for 227 feet inwards, the entire front, as well as the great cavernous sides, being composed of countless complicated ranges of contiguous columns, beautifully jointed, and of symmetrical though somewhat varied forms. A deeply-channelled fissure, parallel to the sides, extends along the whole length of the ceiling, which is ornamented by pendent clusters of columns whitened with calcareous stalagmite. As the sea never entirely ebbs from this cave, it forms its constant flooring, along which in calm weather a boat may be pushed. The water at the entrance is 18 feet deep, at the inner extremity about 9 feet. The average diameter of the basaltic columns throughout the island is about 2 feet, but they often extend to 3 feet and even 4 feet. Their general forms are pentagonal and hexagonal, but the number of sides is sometimes increased to seven and nine, and they are rarely found rhomboidal or triangular. In position they are sometimes erect, sometimes oblique, and not unfrequently horizontal, while they are often curved, and variously jointed and implicated. There are several other caves along the coast of the island, of which the most noteworthy is called Clam-shell Cave, from the peculiar curve in which the basaltic columns recline, giving it somewhat the appearance of a pecten-shell. It is 30 feet in height, 16 to 18 feet broad, and 130 feet long, its lateral dimensions gradually contracting as it recedes from the opening. The Boat Cave and M'Kinnon's or the Cormorant's Cave are two others of less extent and beauty.

**STAFF-COLLEGE**, the school of instruction for officers who wish to be put upon the staff of the British army. The institution, which is at Camberley, about 2 miles from Sandhurst, was founded in 1858. The candidate must be under thirty-five years of age, must have been in active service for five years, must produce a certificate as to character and efficiency from his commanding officer, a certificate of good health and fitness for active duties from a military surgeon, and a certificate of having passed the examination for the rank of captain. The compulsory subjects of examination are mathematics, field fortification, topography, tactics, military law, army administration, and one foreign language (French, German, Russian, Hindustani); while geography, military history, higher mathematics, and two or more of the above languages are optional. The marks obtained in any subject are not counted unless fifty per cent of the total have been earned. The course lasts two years, and at the end of the first year examinations are held in the different branches, students being then expected to obtain sixty per cent of the possible marks. Each student is given four weeks in the second year to travel abroad, his expenses being paid.

**STAFFORD**, a central county of England, bounded on the north-west by Cheshire, on the north-east by Derbyshire, on the south-east by Warwickshire, on the south by Worcestershire, and on the west by Shropshire, whilst a small part in the east marches with Leicester; greatest length from north to south, 55 miles; central breadth, 35 miles; area, 744,918 acres, or 1164 square miles. The surface in the north consists chiefly of wild moorlands, rising in several parts more than 1000 feet above sea-level, and formed of long ridges, which terminate what is called the Pennine Chain of England, and are separated from each other by deep valleys, sloping more or less gradually towards the Trent. The midland

and southern parts of the county are much less elevated, consisting for the most part of level and fertile lands diversified by gentle eminences, though occasionally rising into loftier heights, as in Turner's Hill, the highest peak of which exceeds 900 feet. By far the finest part of the county is the valley of the Trent, which traverses it from the north-west to the south-east, and both by its main stream and its numerous tributaries has been made available for a chain of canals, which give the county the benefit of direct water communication with the Mersey, Humber, Severn, and Thames. The geological formation most largely developed is the new red sandstone, which occupies the whole of the central part of the county, but in the north and south gives place to two valuable coal-fields—the one in the north called the Potteries coal-field, from the number of potteries which have been established upon it, and the other in the south, often called the Dudley coal-field, and celebrated alike for coal and iron. About 14,000,000 tons of coal are raised annually, and over 1,000,000 tons of iron ore, the latter chiefly in the north. From beneath the north coal-field the coarse sandstone called millstone-grit crops out and covers a considerable district; the south coal-field, particularly in the neighbourhood of Dudley, rests on mountain limestone. About three-fourths of the whole surface is arable; but much of the soil is of a cold, clayey nature, fit only for oats, which accordingly form by much the largest of the cereal crops. In most parts a satisfactory system of culture is pursued, and proper rotations are observed. This is particularly the case in the south, where the best land occurs, and friable loams, of a gravelly, sandy, or calcareous nature, admit of the cultivation of wheat. A considerable area is also under barley, this being the third, as regards area, of the grain crops. Along the banks of the streams are many rich meadows, natural or artificial, and grazing forms a very important branch of rural economy. About four-fifths of the total area of the county is under crops, rotation grasses, and permanent pasture. More than 400,000 acres are in permanent pasture, and about 40,000 are under woods and plantations. The manufactures, chiefly of china and earthenware in the north and of iron in the south, are so important that these districts are in the front rank of their respective branches in the kingdom. The former, occupying the extensive and populous district of the Potteries (where are Stoke, Hanley, Burslem, &c.), owes much of its prosperity to the enterprise and ingenuity of the late Josiah Wedgwood; the latter, which includes part of the 'Black Country', carries on the iron manufacture in all its branches, from the mining and smelting of the ore to its conversion into malleable iron and steel, and then into various kinds of ironmongery. The beer of Burton is known all over the world. Staffordshire has the benefit not only of the chain of canals already mentioned, but of a large railway development, the London and North-Western traversing it in a north-westerly direction, and sending out various branches, which connect it with the North Staffordshire, Great Western, and Midland lines. The principal towns are Stafford (the capital), Wolverhampton, Walsall, Hanley, West Bromwich, Burton-upon-Trent, Burslem, Longton, Wednesbury, Stoke-upon-Trent, Newcastle-under-Lyme, Lichfield, Tamworth, Uttoxeter, Bilston, Brierley Hill, Leek, Rugeley, Tunstall, Cheadle, Cannock, and Sedgeley. The county includes seven parliamentary divisions, namely, Burton, Handsworth, Kingswinford, Leek, Lichfield, North-Western, and Western. Pop. in 1891, 1,083,408; in 1901, 1,234,382.

**STAFFORD**, a municipal and parliamentary bor-

ough and market town, capital of the above county, pleasantly situated on the river Sow, and on the main line of the London and North-Western Railway, with branch lines radiating from it. It is in general well-built, consisting of two principal and several minor streets. The environs are pleasant, and studded with handsome mansions and villas. The principal buildings and objects of interest are the Established churches, one of them (St. Mary's) a large and fine old cruciform structure, restored in 1844-47, with an octagonal tower, several richly-decorated windows, and many ancient and modern monuments; another (St. Chad's) a fine specimen of Norman architecture, also recently restored; places of worship for various Dissenting bodies; a well-endowed free grammar and other schools; a county-hall, guild-hall, borough-hall, a county-jail and house of correction, an infirmary, a lunatic asylum, a free library, a museum, county technical instruction buildings, and a theatre. The principal manufacture is that of boots and shoes, for which there are several extensive factories; there are also large tanneries, engineering and electrical works. Stafford is an ancient place, having been of importance before the Conquest. By the Redistribution Act of 1885 it sends one member to Parliament instead of two as formerly. Pop. (1891), 20,270; (1901), 20,894.

STAG. See DEER.

STAG-BEETLE (*Lucanus cervus*), a well-known genus of Coleoptera or Beetles, forming the largest of our British species. The Stag-beetle belongs to the family Lucanidae, and to the Lamellicorn tribe of the Beetle order, in which tribe the tips of the antennæ or feelers are formed of flattened plate-like structures. The genus *Lucanus* itself is recognized by the mandibles or larger jaws in the males being of great relative size, and resemble stags' horns somewhat in shape, the familiar name of this beetle being derived from the conformation of these jaws. The mandibles of the females are short, of smaller size, and curved; and the club or terminal part of the feelers is four-jointed. These beetles are vegetable feeders, and subsist upon the tender leaves and other parts of plants. The larvæ are found in trees, into the substance of which they burrow.

STAGGERS, the name given by veterinarians to a peculiar disease in sheep, recognized, as implied by the name, by the staggering gait of these animals. The disease, curiously enough, has been clearly ascertained to be caused by the presence within the brain of the sheep of the cystic form (*Cœnurus*), or immature embryo of a particular species of tape-worm (*Tænia Cœnurus*), which, in its mature and perfect state, inhabits the intestines of the dog. As explained in the article TAPE-WORM, these parasites, in the course of their development, perform a complicated cycle, and appear to require the presence of two hosts in order to attain maturity. Rudolphi originally described the *Cœnurus*, which he found in the brain of the sheep; and as commonly seen, it exists in various sizes, varying from that of a pea to that of a pigeon's egg; but occasionally when largely developed the *Cœnurus* may attain a length of a foot, and may extend from the brain into the spinal canal. It appears as a bladder-like structure, containing a pale fluid of albuminous nature, and exhibiting small projections on its outer surface. Each of these little projections is in reality the head or scolex of a minute tape-worm, which has grown by a process of budding from the vesicle itself, and which is thereto connected by a narrow stalk or neck, divided transversely into joints, which are in fact the joints or segments of the future tape-worms. Each little head or scolex is armed with a double circle of hooks, and with four suckers, and by means of these structures the future

worm, if fully developed, will adhere to the wall of the intestine of the dog. The *Cœnurus*-vesicle itself is composed of cellular layers numbering six or eight, and crystalline bodies may occur as the result probably of pathological change within the contained fluid. The presence of these *Cœnuri* in the sheep's brain thus give rise to a whirling, unsteady, staggering gait, often accompanied by convulsive or epileptiform convulsions. The means used for giving relief to the animal consist in puncturing or trephining the head over the diseased part, the situation of which may be diagnosed from the variation in the symptoms produced by the different situations of the parasites. But the cure is at the best only of temporary duration, and the animals generally die of stupor or exhaustion. The skull of the sheep in a bad case may exhibit a thinned-out appearance, produced by the absorption of the bony matter; which process of absorption may, in some cases, proceed to actual perforation of the skull. Thus sheep fed with the mature joints or eggs of the *Tænia Cœnurus* of the dog became afflicted in their brains with *Cœnuri*, or the immature forms of that tape-worm; whilst conversely, by feeding a dog with *Cœnuri* from the brain of the sheep, we find that in the dog the immature *Cœnuri* develop into the mature tape-worm. Thus, in the sheep, the *Cœnuri* can never attain to any development beyond that stage; whilst, in the dog, the tape-worm invariably exists in its perfect form only. Sheep derive these pests from the eggs of the tape-worm of the dog gaining admittance to their digestive systems; the eggs, when introduced into the stomach of the sheep, developing into embryos which bore their way through the tissues to the brain, and there develop into *Cœnuri* or Scolices.

STAGHOUND, a breed of dogs now comparatively rare in Britain, and not bred at the present day in the same numbers as in past times. The bloodhound and grayhound are believed to be the progenitors of this breed, which unites, in great measure, the courage and perseverance of the one, with the swiftness of the other. The chase of the stag declined after George III.'s death, and the breed of old English staghounds is now almost obsolete. The modern staghound is usually represented by a large variety of the foxhound; this variety probably having in its turn sprung from the interbreeding of the foxhound with the staghound breed. These dogs are possessed of great powers of endurance, and have been known to pursue a stag without intermission for upwards of 50 miles.

STAHL, GEORG ERNST, a German physician and chemist, born at Anspach in 1660, studied at Jena under Wedelius, and in 1687 became physician to the Duke of Saxe-Weimar. In 1691 he was chosen second professor of medicine at Halle, and rendered his name famous over all Germany by his academical prelections and his publications. He was in 1700 elected a member of the Academia Curiosorum Naturæ. His fame procured him the appointment of physician to the King of Prussia in 1716; and, going to Berlin, he died there in 1734. Stahl was one of the most illustrious medical philosophers of his age: his name marks the commencement of a new era in chemistry. He was the author of the doctrine which explains the principal chemical phenomena by the agency of phlogiston; and though his system was in a great measure overturned by the discoveries of Priestley, Lavoisier, and others, it nevertheless displays powerfully the genius of the inventor. This theory maintained its ground for more than half a century, and was received and supported by some of the most eminent men which Europe had produced. He was also the proposer of a theory of medicine founded on the principle of the dependence of the state of the body on the

mind, in consequence of which he affirmed that every action of the muscles is a voluntary effort of the mind, whether attended with consciousness or not. His principal works are *Experimenta et Observationes Chymicæ et Physicæ* (1731, 8vo); *Disputationes Medicæ* (two vols. 4to); *Theoria Medica vera* (1737); *Fundamenta Chymicæ dogmaticæ et experimentalis* (three vols. 4to).

STAIR, LORD. See DALEYMPLE, JAMES and JOHN.

STAIRS are constructions of horizontal planes raised one above another, forming steps, and affording the means of communication between the different stories of a building. We find no mention of stairs in the treatise of architecture written by Vitruvius; and the traces of ancient stairs still preserved show them to have been narrow, and often with steps about 1 foot in height. Originally the stairs were placed from story to story in straight flights like ladders. They were erected on the exterior of the building, and to shelter them when so placed great projection was given to the roofs. To save the extent of space required by straight flights the stairs were made to turn upon themselves in a spiral form, and were inclosed in turrets. A central axis or newel reaching from the ground to the roof served to support the inner ends of the steps, and the outer ends were let into the walls or supported on notched boards attached to the walls. At a later period the stairs came to be inclosed within the building itself, and for a long time preserved the spiral form which the former situation had necessitated. In modern architecture the apartment in which the stair is placed is called the *staircase*; the horizontal part of the step is called the *tread*, the vertical part the *riser*. When the risers are parallel with each other the stairs are of course *straight*, and the steps are called *flights*; when they wind round a solid or open newel they are termed *winders*. The wide step introduced as a resting-place in the ascent is called a *landing*, and so much of the stair as is included between two landings is called a *flight*. It is a general maxim that the greater the breadth of the tread the less should be the height of the riser, and, conversely, the less the breadth of the tread the greater should be the height of the riser. Experience has shown that a step of 12 inches wide and  $6\frac{1}{2}$  inches high may be taken as a standard.

STALACTITES are formed by the filtration of water containing calcareous particles through pores or fissures in the roofs of those caverns which are frequent in limestone. The water, having percolated through the roofs, remains suspended in drops. Evaporation commences at the exterior of the drop, and the calcareous particles are deposited on the roof of the cavern in the form of a little ring, which extends by degrees till a small tube is produced. The bore of this tube is in most cases diminished by successive deposits till it becomes entirely closed, and the stalactite then increases by concentric layers applied to the exterior. Thus cylinders or cones are produced, and sometimes so enlarged that they unite with each other. While the stalactite is forming a part of the water drops from it on the floor of the cavern or trickles down the sides, and thus produces those calcareous concretions called *stalagmites*. When large they are sometimes called *alabaster*. On the floor they often form large masses, sometimes rising till they meet the stalactites pendent from the roof, and extending in all directions. A great variety of imitative forms are produced; hence a lively imagination will perceive in these caverns representations of the most diverse objects, especially by artificial light. The colour of stalactites is seldom pure white; it more frequently presents shades of yellow, red, or

brown. Among the more remarkable foreign localities of stalactites are the Grotto of Antiparos, in the Grecian Archipelago; Baumann's Cave, in the Harz; Pool's Hole, in Derbyshire; the caves of La Balme, in Savoy; and of Auxelle, in Franche Comté.

STALK-EYED CRUSTACEA, the name given to those groups of the Crustacean class which have their eyes supported on stalks or peduncles, whilst the body is inclosed in a *carapace* or shell, protecting the united head and chest. The Stalk-eyed Crustacea are represented by the orders Stomapoda and Decapoda; the former represented by the Locust and Opossum Shrimps (see SHRIMP), and the latter by the Crabs, Hermit-crabs, Lobsters, true Shrimps, &c.

STALL. See PREBEND.

STALL-FEEDING, a mode of rearing fat stock by keeping each animal tied up separately in a byre or shed and supplying them at stated hours each day with the necessary quantity of food. The advantages of this system are that much less food is wasted and much more manure is obtained. Its disadvantages are that more labour is required for cutting and carrying the food from the field to the byres and that the flesh of the animals from want of exercise wants the rich flavour of that of stock pastured at large. To remedy this defect it has hitherto been the custom in some parts of the country at least to fatten them in open yards, with sheds of a size to accommodate two or three animals, and to feed them with turnips and straw alone. Other modes have been recommended, of which we may mention the two following:—Keeping the cattle individually in boxes of from 9 to 12 feet square; boxes combine to a large extent the advantages of the stall and the yard, as their inmates are safe from cold and disturbance, have room for moderate exercise, require less attendance than those in stalls, and less litter than those in yards, while the manure made in them being protected from the weather, and retaining the urine, is superior to that produced in the other plans. The second plan consists in roofing over the entire yard so as to protect effectually the cattle, food, and manure from the vicissitudes of the weather, and in tying up the cattle for each meal and loosening them when it is dispatched, by which means they feed undisturbed and get sufficient exercise. The system hitherto followed of giving cattle as many sliced turnips as they could eat, though it has produced excellent fat cattle, is yet defective in several important respects. The digestive organs of the ox being formed with a manifest adaptation to his living upon very bulky and but moderately nutritious food, such as grass or hay, it is indispensable to his comfort that his capacious paunch be constantly full; hence it happens that when fed with substances of a much more nutritious quality than these he must have his fill before he will go to rest and proceed with his rumination and digestion. But although he can eat nearly as much bulk of the richer food as of the other his power of assimilation is not correspondingly expansive, and therefore if this law of his constitution is violated not only must a serious waste of food ensue but usually continued diarrhoea and sometimes more serious diseases set in. Several plans have been adopted for obviating this evil. One is to limit the turnip-feed until the cattle are fain to appease their appetite by eating straw much more largely than they would otherwise do. But there is some difficulty in getting cattle to eat straw in sufficient quantity by simply offering it to them dry; and hence a plan has been adopted of reducing it to chaff by the straw cutter, mixing with this chaff small quantities of bruised linseed, bean or other meal and salt, and then by infusion in boiling water or steaming in a close vessel to incorporate these ingredients, impart to the straw a flavour grateful

to bovine palates, and so induce a willing consumption of this cheap and bulky substance in such quantity as makes 1 ton of roots equal in fattening power to 2 tons when used in the common method.

**STALYBRIDGE**, a municipal and parliamentary borough of England, in the counties of Lancaster and Chester,  $7\frac{1}{4}$  miles east of Manchester, on declivities on both banks of the Tame. The principal public buildings include the town-hall, free library, post-office, St. George's church, an octagonal building, and several churches and chapels for various Dissenting bodies. Spinning cotton yarns and weaving calicoes are the principal manufactures carried on here. Some of the establishments are very extensive, employing from 1000 to 1400 persons each. There are also iron-foundries, and machine and mill-wright shops. Stalybridge is well supplied with railway communication; the Great Central Railway and the London and North-Western have a joint station. Stalybridge has returned a member to the House of Commons since 1867, and has been a municipal borough since 1857. As a town its history dates only from about 1776. Pop. of parl. bor. in 1891, 44,135; in 1901, 46,553.

**STAMBOUL.** See CONSTANTINOPLE.

**STAMENS**, in botany, the fertilizing organs situated in the flowers of phanerogamous plants. The stamen is generally composed of three parts: 1, the *anther*, a kind of membranous bag, having a double internal cavity formed of two cells in contact with each other; 2, the *pollen*, a substance commonly formed of small vesicular grains, which contain the parts necessary for fecundation; 3, the *filament*, a thread-like appendage, by which the anther is frequently supported. Of these three parts, however, two only are essential, the anther and the pollen. The filament is merely an accessory part of the stamen, and is often wanting, the anther being then directly attached to the body on which it is inserted without the intervention of a filament, in which case the stamen is said to be *sessile*. The essence and perfection of the stamen consists in the presence of the anther; but in order that this organ may be fitted for the performance of the functions allotted to it by nature, it must not only contain pollen, but must also open, that the pollen may come in contact with the stigma; otherwise fecundation could not take place. The stamens vary in number in the different families of plants. Some plants have only one stamen, as the Hippuris, or mare's tail; others have two, as veronica; others three, as the grasses; and so on till we come to many hundreds. Their normal position is below the inner whorl or the pistil, as in ranunculus, and when so placed they are said to be *hypogynous* (Greek, *hypo*, under, and *gynē*, a wife); sometimes they become united to the petals, as in veronica, and are *epipetalous* (Greek, *epi*, upon, and *petalon*, a leaf); when the stamens are inserted on the calyx, that is, become united to it to a greater or less height above the pistil, then they become lateral as in regard to it, and are *perigynous* (Greek, *peri*, around), as in the flower of the almond; when inserted upon the ovary, as in the orchis tribe, they are *epigynous*. The stamens, though very different in their shape and structure from the petals, exhibit, however, strong indications of being nearly allied to them, and the two seem in some cases, as in the flower of the *Nymphaea alba* or white water-lily, to run naturally into each other, the inner petals being partly stamens, or the outer stamens being partly petals. But in many flowers, particularly the polypetalous, the stamens are entirely convertible into distinct petals, and are often so converted either in part or in whole. In the former case the flower is said to be double, in the latter it is said to be full. But this singular

conversion of stamens into petals is regarded by botanists as altogether an aberration from the laws of vegetable economy, and occurs but seldom except in consequence of culture. The anemone, ranunculus, rose, camellia, and tulip, when cultivated in our gardens, afford examples of the flowers of this description. The anther is generally attached to the tip of the filament, but sometimes the latter is prolonged above the insertion of the anther. The stamens are in general free and unconnected with each other, but in certain cases they are more or less united by the filaments, which form a tube. When the filaments are all connected together, either by the sides or at the base, as in the mallow, they are said to be *monadelphous* (Greek, *monos*, one, and *adelphos*, brother); when they are united into two distinct bundles, as in the common pea, they are *diadelphous* (Greek, *dis*, twice); when united into three or more bundles they are *polyadelphous* (Greek, *polys*, many). The anther is generally formed of two membranous bags attached to each other by their sides, joining or united by an interposed body. Each of these bags or cells is united internally into two parts by a partition, and the cells open at the period of fecundation to allow the pollen to escape. Sometimes the anther consists of only one cell, as in the hazel, mallow, and pine; more rarely there are four cells. Each of the cells has on one side a longitudinal groove where the opening takes place. Sometimes the pollen escapes by pores or slits in the summit of the anther, as in the heaths, the potato, &c.; in other cases their pores are furnished with movable valves, as in the barberry, laurel, &c. The pollen or substance contained in the cells of the anther generally presents the appearance of a powder composed of extremely minute grains; sometimes it is in solid masses of greater or less size, as in the orchidea; and is termed the pollinium or pollen-mass (see POLLEN). See BOTANY.

**STAMFORD**, a municipal borough of England, partly in Northampton and partly in Lincolnshire, on the navigable Welland. It is an ancient and irregularly built town, the houses being generally of freestone, covered with slate. It contains six parish churches and two or three other places of worship. All-Saints' Church is an ancient and handsome structure with a lofty embattled tower and octagonal crocketed spire; St. Mary's (erected at the end of the thirteenth century on the site of one dating from the Conquest) exhibits some fine specimens of early English architecture, and St. John the Baptist's (dating from the middle of the fifteenth century) has a fine wooden roof and screen. The other public buildings are a town-hall, corn exchange, assembly-rooms, club-house, several endowed and other schools, &c., and there are several charitable establishments, including a general infirmary for the district. There are manufactures of agricultural implements, and a large malting business is also carried on. The Midland Railway runs through the town, and it is connected with the Great Northern and London and North-Western Railways by branch lines. By the act of 1885 it ceased to have a separate representation and was merged in the two counties. Pop. in 1831, 8773; in 1891, 8358; in 1901, 8229.

**STAMFORD**, a post-borough and township of Fairfield county, Connecticut, United States, near the mouth of the Mill River, 36 miles north-east of New York, with which it is connected by rail. It contains eight or ten fine churches, and many of the other buildings are elegant. It is much resorted to during the summer months as a watering-place by the wealthier classes of New York. It has woollen and iron manufactures, and a small coasting trade, which is facilitated by a canal extending from the

borough to the bay, which sets up from Long Island Sound. Pop. (1880), 11,297; (1890), 15,700.

**STAMMERING.** See **SPEECH**.

**STAMPS, STAMP-DUTIES.** Stamps are impressions made upon paper or parchment by the government or its officers for the purpose of revenue. They always state the price of the particular stamp, and sometimes specify the nature of the document itself on which they are impressed. If the instrument is written on paper, the stamp is impressed in relief on the paper itself; if on parchment, the impression is attached to it. Stamped paper seems to have been first legally introduced by the Dutch United Provinces in 1624, and its use was gradually adopted by other governments. Stamp-duties were first imposed in England in the reign of William and Mary (5 William and Mary, cap. xxi.), and included a variety of duties levied on grants from government, diplomas, contracts, probates of wills, and letters of administration; and upon all writs, proceedings, and records in courts of law and equity. Two years later conveyances, deeds, and leases were subjected to the stamp-duty, and by a series of acts in the succeeding reigns every document recording a transaction between two individuals had to be stamped before it could be given in evidence. By 38 Geo. III. cap. lxxviii. a stamp-duty was imposed on newspapers, but was abolished in 1855. Legacies are largely taxed by means of stamped receipts. Stamps are also used as a convenient way of imposing a tax upon particular classes of persons: thus articles of apprenticeship and of clerkship to a solicitor are subject to duty, as are admissions of any person to practise in any court; to the degree of barrister-at-law; as solicitor, writer, or proctor in any court; as a notary public; as a fellow of the Colleges of Physicians in England, Scotland, and Ireland; as burgess of any corporate town, &c. Stamp-duty is also imposed on grants by letters-patent of the honour or dignity of a duke, marquis, earl, viscount, baron, and baronet; on warrants of precedence to take rank among the nobility under the sign-manual; on military and naval commissions, &c. In order to protect the revenue, the stamp acts usually impose a penalty upon any fraudulent evasion of their provisions, and formerly an instrument unstamped or improperly stamped could not be given in evidence, but provision has now been made in many cases for the admission in evidence of such documents, on payment of the stamp-duty and penalty to the proper officer of the court. It may be remarked that the endeavour of England to impose stamp-duties on her transatlantic colonies in 1765 was among the efficient causes of the revolution which led to the independence of the United States. The income derived by the British government in 1900-01 from stamp-duties amounted to about £7,800,000.

**STANDARD.** See **FLAG**.

**STANDARD, BATTLE OF THE,** in English and Scottish history, a battle in which David I. of Scotland, who had espoused the cause of Maud against Stephen, was signally defeated by the English under the Bishop of Durham. It was fought in the neighbourhood of Northallerton, in Yorkshire, on the 22d of August, 1138, and it got its name from the fact that the English forces were gathered round a tall cross mounted on a car, and surrounded by the banners of St. Cuthbert, St. Wilfred, and St. John of Beverley. A peace was concluded between the two countries in the following year, David acknowledging the claims of Stephen to the throne of England.

**STANDARD OF MONEY.** See **COINING** and **CURRENCY**.

**STANDING ORDERS,** permanent regulations

for the conduct of business in the two houses of Parliament. They have been gradually formed since 1625. In the House of Commons there were no standing orders for public bills till 1854, when a body of regulations of this nature was framed and printed by order of the House. Sometimes standing orders are suspended. In the House of Lords no standing order can be made or dispensed with on the same day on which the motion with such object is made, or until the House has been summoned to consider it. The rescinding of a standing order is called vacating it in the House of Lords, and repealing it in the House of Commons. An edition of the standing orders of both Houses is published every year.

**STANDING STONES.** In our article on sculptured standing stones some account of one class of the ancient remains that form the subject of this article will be found, and the present article will accordingly be confined to unsculptured standing stones. Such stones are found not only in all parts of Europe, but also in some countries of the East and even in the New World, and nowhere are they more common than in Great Britain. Sometimes they stand singly, sometimes in groups. Single standing stones of this nature are to be found in every parish of Scotland, and the most of them show no marks of having been prepared in any way. They have simply been set up as they were with the lower end imbedded in the earth, and they are thus of all shapes and sizes. The two principal objects of these single standing stones appear to have been to serve as boundary-marks and as memorials of some kind or other, most frequently in the latter case as sepulchral monuments. The designation 'bare stanes,' common in this country for single standing stones, is explained by some as meaning boundary-stones; and the places bearing names apparently derived from 'Cambus stone' are conjectured to have acquired their names from some stone placed at the bend (Gaelic, *cam*) of a river or some other natural feature of that form, and marking the boundary between the lands of different owners. Of the use of standing stones to serve as memorials, several examples are recorded in the Old Testament. The earliest instance is that in which Jacob sets up a pillar of stone to be a witness of the covenant between him and Laban (Gen. xxxi. 45). The standing stones in Scotland bearing the name of 'Cath-stanes' are supposed to be memorials of battle, *cath* being a Celtic word for battle. Tanist-stones were those at which a new king or chief was elected. Such was the Lia Fail, or 'stone of destiny,' on which at their coronation the kings of Scotland sat (see **CORONATION**); and such the pillar in Shechem, where Abimelech was made king (Judges ix. 6). A number of these single standing stones are perforated, and there are various traditions connecting these with pagan rites and superstitions. One of these stands in the centre of a circle of standing stones at Applecross, in the west of Ross-shire. Another, called the Clachcharra, or stone of vengeance, may be seen at Onich, near Bala-chulish, Argyleshire. A more celebrated one than either stands near the ring of Brogar, in the Island of Pomona, in Orkney. It is called the stone of Odin. Reference is made by Sir Walter Scott in the *Pirate* to the superstitious veneration in which it was held by the natives. In the novel mentioned he makes one of the characters allude to the practice of lovers plighting their truth by joining their hands through the hole in this stone as 'the most sacred of northern rites yet practised' among the natives of those islands.

The groups of standing stones that exist in various parts of Great Britain, as well as in some parts of the

Continent, are of much greater interest, and have been the subject of much more speculation than the single standing stones. The most remarkable and best preserved of these groups are those of Avebury and Stonehenge in Wiltshire; that of Carnac in Brittany; that of Callernish, near Loch Roag, in Lewis, in the Hebrides; and the circles of Brogar and Stennis in Pomona in Orkney. Remains of ancient groups less perfect than those just mentioned are common, and may be seen, among other places, at Pitlochrie in Perthshire, and near Largo Bay in Fifeshire (the 'standing stones of Lundin'). These groups are sometimes in the form of a circle, and sometimes in other forms, as in that of a cross with a circle at the intersection of the branches. In their perfect state some of these groups covered a very large area, and even yet that of Carnac extends over 8 miles in length. Many of the unhewn stones now standing alone probably formed at one time parts of groups, which have been to so great an extent destroyed that the connection of these solitary stones with them can no longer be observed, or which have been altogether destroyed, with the exception of the single stones that mark their site. What the purpose of these groups of standing stones was is not known. The general opinion of antiquaries formerly connected them with the Druidical worship of the Celts, but this theory is now for the most part given up, along with many other old theories of the Druids. In some cases there are facts tending to show that the groups were designed to have an astronomical significance of some sort—that they were perhaps connected with the worship of the heavenly bodies. This is exemplified in the group of Callernish. This group is in the form of a cross, with a double line of stones, forming an avenue stretching from the place of intersection to the north, while the other arms consist of single lines of stones stretching east, west, and south. At the place of intersection is a circle of stones, and in the centre of this circle a stone nearly 17 feet in height; and when a person stands at the extremity of the southern arm of the cross, and looks along the tops of the stones forming that arm to the top of this central one, he sees the pole-star almost exactly in a line with the row of summits along which he is looking. See AVEBURY, CARNAC, STENNIS, and STONEHENGE.

STANHOPE, the name of a noble English family, to which three peerages belong—those of Chesterfield (dating as the barony of Stanhope from 1616, and as the earldom of Chesterfield from 1628); Stanhope (barony, 1717; earldom, 1718), and Harrington (barony, 1729; earldom, 1742). James, first Earl Stanhope, belonged to a younger line of the Chesterfield branch of the Stanhope family, and was born in Paris in 1673. He entered the army, and served as brigadier-general under the Earl of Peterborough at the capture of Barcelona in 1705. In 1708 he was appointed commander-in-chief of the British forces in Spain, and in the same year he took Port Mahon, and thus made himself master of the Island of Minorca. After the accession of George I. he devoted himself to politics, and became the favourite minister of that monarch, to whom he owed his titles of baron and earl. He died in 1721.—Charles, the third earl, grandson of the preceding, born in 1753, is celebrated chiefly as an inventor and a patron of science. As a member of the House of Peers he exhibited very advanced views, hailing with pleasure the dawn of the French revolution, and openly avowing republican sentiments. Parliamentary reform, the abolition of negro slavery, the freedom of the press, and the independence of juries were the principal things advocated by him in his writings. His chief inventions were an arithmetical

machine; a new printing-press, which bears his name; a monochord for tuning musical instruments, and a vessel to sail against wind and tide. He was twice married—first to Lady Hester Pitt, daughter of the great Earl of Chatham, and by her he became the father of the celebrated Lady Hester Stanhope. The fifth Earl Stanhope (1805–75), the grandson of the last noticed, is celebrated in literature as the author of a History of England from the Peace of Utrecht to the Peace of Versailles (1713–83), and of some other works; and he was the founder of the Stanhope Prize for an historical essay in connection with Oxford University.

STANHOPE, LADY HESTER LUCY, an English lady, daughter of the third earl Stanhope (see above), famous for her singular mode of life. She was born in London in 1776, and in 1806, on the death of her uncle, William Pitt, over whose domestic establishment she had presided, received a pension. In 1810 she left England, and after travelling over various parts of the East, determined to settle in Syria, where she resided for the rest of her life, living latterly about 8 miles from Sidon, at a villa of her own construction, called D'Joun. It is situated on a solitary mountain, remote from any village. Dr. Madden, who went to see her in 1827, gave the following account of his visit:—"Everything without was wild and barbarous, and all within confessed the hand of taste. I was led from the court into a little garden, at the extremity of which there was a sort of kiosk, consisting of two rooms—a sitting room and a bed-room—furnished, in the European style, with chairs and tables. The room into which I was ushered was in the Arab style; and at the farther corner I perceived a tall figure, in the male attire of the country, which was Lady Hester herself. For seven hours there never was a pause in the conversation. Every subject connected with Oriental learning was discussed, and every observation of her ladyship's evinced a degree of genius that astonished me, and was couched in such forcible and energetic language as to impress me with the idea that I was conversing with a woman of no ordinary intellect. The peculiarity of her opinions in no wise detracted from the general profundity of her reflections; and, though I could not assent to many of her notions regarding astral influence and astrological science, I had no reason to alter my opinion of her exalted talents, though they were unfortunately directed to very speculative studies. Nothing is more difficult than to ascertain the point where eccentricity terminates and insanity begins; at all events, I am sure that whatever may be the eccentricity of Lady Hester Stanhope, her mind is unimpaired, and that few women can boast of more real genius, and none of more active benevolence." Lady Hester showed Dr. Madden a horse which she said was of the race of Solomon's favourite steed, saddled by the hand of God (there was an indentation in the back, resembling a Turkish saddle). The rich presents which she made to the Turkish pashas gave her a great influence over them for a time; but at the time of Dr. Madden's visit, this was greatly diminished. The Bedonins, however, or wild Arabs, whom her wisdom and kindness had won, still continued to look up to her, not only as a benefactor, but as a being of a superior order. Her belief in magic and astrology, and her contempt for danger, may also have contributed to extend her influence. She died June 23, 1839. Among her visitors were Lamartine (1832) and Kinglake (1835). See the latter's *Eöthen*. Her physician, Dr. Meryon, wrote *Memoirs of Lady Hester Stanhope* (1846, three vols.).

STANHOPE, PHILIP DORMER. See CHESTERFIELD.

**STANISLAU**, or **STANISLAW**, a town in Austria, Galicia, 74 miles S.S.E. of Lemberg. It is fortified, and has various district courts, a Roman Catholic church, and several United Greek Catholic churches, a gymnasium, and other schools, and an important general trade. Pop. (1890), 22,230; (1900), 29,628.

**STANISLAU**, or **STANISLAUS I.**, King of Poland, afterwards Duke of Lorraine and Bar, was born at Lemberg, in 1677. His family name was Leszczynski, and his father held the important post of grand treasurer to the crown. He very early displayed indications of an amiable and estimable character, and at the age of twenty-two was intrusted with an embassy to the Ottoman court. In 1704, being then woywode of Posnania, and general of Great Poland, he was deputed by the assembly of the states at Warsaw to wait upon Charles XII. of Sweden, who had invaded the kingdom with the view of dethroning Augustus of Saxony. (See **AUGUSTUS II.**) In a conference with the Swedish monarch, he so rapidly acquired his esteem, that Charles immediately resolved to raise him to the throne of Poland, which he effected at an election held in the presence of the Swedish general in July, 1704. He was, however, soon after driven from Warsaw by his rival Augustus; but another change brought him back to that capital, where he was crowned, with his wife, in October, 1706; and the next year Augustus was compelled formally to abdicate. (See **CHARLES XII.**) The fatal defeat of his patron, Charles XII., at Pultava, in 1709, again obliged him to retreat into Sweden, where he endeavoured to join Charles XII., at Bender, in disguise; but, being detected, he was held captive in that town until 1714. Being then suffered to depart, he repaired to Deux-Ponts, where he was joined by his family, and remained until the death of Charles XII., in 1719, when the court of France afforded him a retreat at Weissenburg, in Alsace. He remained in obscurity until 1725, when his daughter, the Princess Mary, was unexpectedly selected as a wife by Louis XV., king of France. On the death of Augustus, in 1733, an attempt was made by the French court to replace Stanislaw on the throne of Poland; but, although he had a party who supported him and proclaimed him king, his competitor, the electoral Prince of Saxony, being aided by the Emperors of Germany and Russia, he was obliged to retire. (See **POLAND** and **AUGUSTUS III.**) He endured this, like every other reverse of fortune, with great resignation, and, at the peace of 1736, formally abdicated his claim to the Kingdom of Poland, on condition of retaining the title of king, and being put in possession for life of the Duchies of Lorraine and Bar. Thenceforward he lived as the sovereign of a small country, which he rendered happy by the exercise of virtues which acquired him the appellation of 'Stanislaus the Beneficent.' He not only relieved his people from excessive imposts, but, by strict economy, was able to found many useful charitable establishments, and to patronize the arts and sciences. He was himself fond of literature, and wrote some treatises on philosophy, morals and politics, which were published under the title of *Ouvres du Philosophe bienfaisant* (four vols. 8vo, 1765). He died in 1766.

**STANISLAW II.** (*Stanislaus Augustus*), the last King of Poland, was the son of Count Stanislaw Poniatowski, and was born at Wolczyn in Lithuania, on January, 1732. In 1752 he first appeared as a deputy in the Polish diet, where he soon attracted attention by his oratorical gifts, as well as by his handsome figure. The king, Augustus III., sent him on a mission to the Empress Elizabeth at St. Petersburg, and on this occasion he acquired the peculiar favour of the grand Princess (afterwards Empress)

Catharine. After the death of Augustus, the influence of Catharine secured the election of her favourite as his successor (Sept. 1764), and he was crowned at Warsaw on the 25th of November, 1764. Although a man of excellent ability and highly cultured, and of a noble disposition, he was yet unable to do anything for the good of his country, because he had not the strength of character necessary to keep in check the license of the nobles, and to withdraw himself from Russian influence. By most of his fellow-countrymen he soon came to be regarded as a mere creature of Russia. The discontented nobility therefore met in confederation at Bar to project measures against the king (1768), and having declared the throne vacant, some of their number, on the night of the 3d November, 1771, seized Stanislaw in Warsaw, and carried him to a wood in which they concealed him. But he soon managed to make his escape. When he found himself alone on one occasion with one of the conspirators, he so overpowered his guard by the might of his eloquence, that the latter set him at liberty. In 1772, when the first partition of Poland was made, Stanislaw in vain protested against it, and he found himself obliged to put himself even more than formerly under Russian influence. By the acceptance of the constitution of May 8d, 1791, he regained the esteem of his people, and he then seemed resolved to bid defiance to Russia, but soon after, being discouraged by the altered sentiments of Prussia and the menaces of Russia, he joined the confederation of Targowicz, and thus raised the indignation of the most patriotic of his subjects against him, and that without effecting his object of reconciling Poland with Russia. His resistance to the second partition of Poland had only this consequence, that after the capture of Warsaw the Empress Catharine caused him to be brought to Grodno, where he was compelled to sign the treaty for the third partition of Poland, and on the 25th of November, 1795, also to sign his own abdication. After the death of Catharine, Paul I. brought him to St. Petersburg, where he lived for the rest of his life on a pension allowed him by the emperor, and died on the 12th of February, 1798. See the *Mémoires secrets et inédites de Stanislas* (Leipzig, 1862).

**STANNARIES**, COURT OF, a court of special and limited jurisdiction for the tin mines of Devonshire and Cornwall. Stannary courts were constituted in virtue of a privilege granted to the tinners in those counties to have all cases, in which they were parties, tried before their own courts, in order that they might not be drawn from their business, which is profitable to the public. The vice-warden of the duchy of Cornwall is the judge before whom cases belonging to this court are tried in the first instance, and from his decision there was formerly an appeal to the lord-warden, but by the Judicature Act of 1873 his jurisdiction is transferred to the Court of Appeal.

**STANOVOL**, or **YABLONOI**; a mountain-chain in the north-east of Asia, which, breaking off from the ranges in the north of Mongolia, proceeds first E.N.E., forming the boundary between Siberia and Manchuria, then N.N.E., almost skirting the sea of Okhotsk, and is continued, though with gradually diminishing height and partial interruptions, to the shores of Behring's Strait. The whole length of the chain has been estimated at not less than 3000 miles. The southern part of the chain, which is that which is more properly called Yablonoi, commences in the south of Lake Baikal, with the peak of Sochondo (8250 feet high), and then proceeds north between the basins of the Lena and the Amoor, until it reaches the neighbourhood of Udskoi, near the sea of Okhotsk. The elevation of the northern portions of this part of the chain is considerably less than

that of the southern portions. At various parts the range has, indeed, more of the character of a plateau than of a range of mountains. The northern part of the whole chain is the chain of the Stanovoi mountains proper, which reaches its highest elevation, about 5000 feet, to the west of Aian, on the sea of Okhotsk. In the extreme north-east a remarkable range detaches itself from the Stanovoi range, and proceeds south through the centre of the peninsula of Kamchatka. It may be considered as forming one of the links of a vast chain of volcanoes. The Stanovoi range, taken as a whole, is more remarkable for its length than for its height. Below the parallel of 60° the summits are covered with snow only during part of the year, and up to the parallel of 55° are generally clothed with dense forests. Between 55° and 63° trees begin to become rare, and are seldom met with, except in very stunted forms, in higher latitudes. The Stanovoi mountains give rise to a great number of important streams. Of these few of great magnitude descend from the south and east side of the chain except the Amoor and the Anadir; the north and west side furnishes either the source or the principal feeders of the Yenisei, Lena, Indighirka, and Kolima. The whole chain appears to be rich in metallic deposits, including gold, copper, and iron, &c. The most valuable yet found is in the district of Nertchinsk, forming the east part of the Russian government of Irkutsk, where, in addition to large quantities of gold, many precious gems also are obtained.

**STANZA** (Italian); a strophe or number of verses so connected with each other by metre and rhyme as to form one of the regular divisions of a poem. In Italian the word is used in a special sense to denote that form of stanza commonly called the *ottava rima*. The most celebrated stanza of English invention is the Spenserian. See *OTTAVA RIMA*, and *SPENSER*.

**STANZE**. See *RAPHAEL* and *VATICAN*.

**STAPELIA**, a genus of plants belonging to the natural order Asclepiadaceæ. It comprises plants of a singular appearance, with fleshy, angular, knotty stems, and without leaves, and altogether reminding one of the cactus tribe. The flowers are large and beautiful, of various colours often variegated. All the species have a disagreeable fetid odour resembling that of putrifying animal matters, whence they are commonly known as carrion-flowers. Most of them are natives of the Cape of Good Hope. Among the principal species are *Stapelia grandiflora*, with large flowers of a deep purple colour; *Stapelia hirsuta*, also with large flowers, but of a yellowish colour streaked with brown; *Stapelia variegata*, the flowers of which have transverse furrows, and are of a yellowish colour with brownish-red spots. Some of the species are used as food by the Hottentots, and the people of Cape Colony also use them in the form of a pickle. They were first introduced into the gardens at Kew at the end of the 18th century. They thrive best in a sandy loam mixed with old lime or brick rubbish. If planted in a richer soil they thrive better for a time and produce larger flowers, but are very apt to rot off, particularly if watered too freely. They are readily propagated by cuttings. These should be laid to dry in the stove till they begin to shrivel, and if planted in this state in pots, they will root in a very short time.

**STAPLE**; a public market, whither merchants are obliged to carry their goods for sale. Formerly, merchants, in various countries, were obliged to carry their wool, cloth, lead, and other commodities to particular places, in order to utter the same by wholesale. In England, the commodities mentioned, from the fact of their being the commonest exports, came to be called the staple commodities, and this name

was especially given to wool, in early times England's leading export. There seems to have been a double object in fixing on certain places as staples, first to consult the convenience of foreign merchants, and second, to facilitate the collection of the customs' duties. *Merchants of the staple* was the denomination of the most ancient commercial society of England, from their exporting the staple wares of the kingdom. It is said to have originated in 1248. By an act of the twenty-seventh year of the reign of Edward III., known as the statute of staple, various towns in England, Wales, and Ireland were fixed upon as staples. The law administered at the staples was not the same with that which was in force for the rest of the country, but was the commercial law or law merchant. (See *COMMERCIAL LAW*). The court by which it was administered was of great antiquity, and consisted of a mayor and two constables, elected by the merchants attending the staple, both native and foreign, and of two alien merchants. There were also six mediators connected with the court, whose duty was to intervene in questions between buyers and sellers. The chief continental staples were those of the Netherlands.

**STAR**, a luminous discrete body existing outside the solar system. Stars are self-luminous bodies, resembling the sun. To distinguish stars from planets stars have been called fixed stars. Our most definite information about stars is due to spectrum analysis, for this has enabled us to say confidently that in the atmospheres of these far-distant orbs matter exists which is identical with matter existing on the earth. We propose to discuss the application of spectrum analysis to distant sources of light in the article *SUN*. See *CONSTELLATION*, *FIXED STARS*, *SIDEREAL SYSTEM*.

**STAR, FALLING** or **SHOOTING**. See *METEOR* and *METEORIC STONES*.

**STAR, POLAR** (*ORDER OF THE*), a Swedish order, the origin of which is unknown. It is bestowed specially on those who have distinguished themselves in a civil capacity. Its motto is, 'Nescit occasum.'

**STARAI-A-RUSSA**, a town in Russia, in the government of Novgorod, and 40 miles south of the town of Novgorod, on the Polister. It has an imperial palace, a military colony, important salt-works, and a considerable trade in salt, flax, linseed-oil, wood, and lime. Pop. (1893), 15,589.

**STAR-APPLE** (*Chrysophyllum Cainito*), a plant belonging to the natural order Sapotacæ, a native of the West Indies. It grows on a moderately-sized spreading tree, with slender flexile branches. There are more than one species, or at least more than one variety of the fruit. The star-apple, properly so called, bears fruit resembling a large apple, which, in the inside, is divided into ten cells, each containing a black seed surrounded by a gelatinous pulp. The milky juice, both of the tree and the fruit before it is ripe, is remarkably astringent, but when the fruit ripens it is sweet and very pleasant to the taste.

**STARBOARD**; the right side of a ship when the eye is directed forward.

**STARCH**. This name is given to a white substance which is found in every plant at some period of its life-history. Starch is specially abundant in wheat, potatoes, arrow-root, and other similar plants; it occurs in the albumen of the seeds, in the cotyledons of the embryo, in the pith, the bulbs, stems, &c. This substance appears to be formed in plants in greatest quantity when there is a large supply of nutriment, and we find that it disappears when the nutriment becomes deficient. The amount of starch in various alimentary substances is exhibited in the following table:—

Name of Substance.	Starch in 100 Parts.
Haricot-bean flour,.....	99-96
Wheat-flour,.....	57 to 67
Rye-flour,.....	54 to 61
Oats,.....	30 to 40
Barley-flour,.....	64
Barley,.....	38 to 42
Maize,.....	65 to 66
Maize-flour,.....	77 to 78
Potatoes (air-dried),.....	16 to 23

Starch is prepared from potatoes, wheat, rice, &c. In potatoes the starch granules are inclosed in cells, the walls of which must be broken before the starch is obtained in a form suited for use. In order to effect this breaking of the cell walls the potatoes are placed in a grinding cylinder, furnished with saw-teeth 9 inches or so in length, which revolves 600 or 700 times per minute. In this machine the potatoes are ground to a pulp, which is then caused to pass over gratings, where it is subjected to the repeated action of a stream of water. The starch granules are thus separated by the water, from which they settle down in the form of a fine white powder. This powder is collected and dried, either by being spread in thin layers over a porous surface, or by the action of centrifugal machines. Starch is prepared from wheat by soaking the wheat in water, pressing it under rollers until soft, and allowing the white, milky fluid to stand for several days, when fermentation sets in, and the gum contained in the wheat is gradually oxidized, and removed by washing with water.

The residual starch is now separated by pressure from any husk or gum which it may yet contain, and is then washed through a fine sieve, and finally dried. Rice starch is produced by subjecting the rice to the action of very dilute soda lye, whereby it is softened; after washing, grinding between rollers, and again washing on a sieve, the starch is separated from the husk, gum, &c., and after drying is manufactured into any required form.

Starch is a soft, white, shining powder; under the microscope it is seen to consist of a number of granules, each of which is formed of a series of envelopes concentrically arranged round a common nucleus; inasmuch as these layers or envelopes are of variable thickness they cause the granule to assume more or less an ovoid form. The diameter of starch granules varies, according to Payen, from .002 to .185 millimetres: the diameter of wheat-starch granules being about .05, while that of potato-starch granules averages .18 millimetres. Starch has a specific gravity of 1.5; it is without taste, smell, or action on test-papers. Starch dried at ordinary temperatures always retains an amount of water varying from 12 to 18 per cent.; but by drying in a vacuum at 100° it may be obtained perfectly free from water. Starch is insoluble in cold water, alcohol, and ether; but if it be boiled with water the starch granules are swollen and broken up, so that on cooling, a stiff, gelatinous mass called *starch-paste* is produced; on largely diluting this paste with water the swollen granules for the most part subside, but a considerable quantity of starch remains in solution. By boiling starch mixed with a quantity of water, under pressure, at a temperature of about 150°, it is mostly dissolved, and on filtering the liquid and allowing it to cool small granules of starch are deposited, which are slightly soluble in cold water, and are at once dissolved by water heated to 70° C. This modification of starch is known as *soluble starch*. By the action of dilute acids starch is gradually converted into dextrine (which see), and then into glucose. Starch may be detected by boiling with water, cooling, and adding tincture of iodine, when a splendid deep blue colour is produced; this colour is destroyed by heat, or by substances such

as alcohol, ether, &c., which dissolve and so remove the iodine.

Nitric acid acts on starch in different ways, according to the strength of the acid used and the temperature. Cold concentrated nitric acid forms a substitution product, in which one hydrogen atom of the starch is replaced by the group NO<sub>2</sub>. A mixture of concentrated nitric and sulphuric acids gives rise to the formation of a dinitro-substitution product, in which two atoms of hydrogen are replaced by the group NO<sub>2</sub> twice. From these and other facts the formula C<sub>6</sub>H<sub>10</sub>O<sub>5</sub> is deduced for starch. Hot nitric acid converts starch into oxalic, malic, and acetic acids.

**STAR-CHAMBER** (*camera stellata*), a room in the old House of Lords, so called from its ceiling being adorned with gilt stars, or, according to some, because it was originally the place of deposit of the Jewish stars (*starra*) or covenants. The despotic tribunal, which sat here, was also called the *star-chamber*. This tribunal was either created or remodelled by Henry VII. Those who hold that it was merely remodelled by that monarch think that its original is found in the king's ordinary council (*concilium ordinarium*) as distinguished from the privy council (*concilium privatum*). It was under the direction of the chancellor, and had jurisdiction of forgery, perjury, riots, maintenance, fraud, libel and conspiracy, and in general of every misdemeanour, especially those of public importance, for which the law had provided no sufficient punishment. It was this criminal jurisdiction (its civil having gone into disuse) that made it so powerful and odious an auxiliary of a despotic administration. Its process was summary, and often iniquitous, and the punishment which it inflicted, often arbitrary and cruel. It became particularly violent in the reign of Charles I.; and it was abolished by the Long Parliament in 1641 along with the no less hateful High-commission Court, which had been established in 1584 to exercise the same jurisdiction in ecclesiastical matters as the Star-chamber did in other matters. Its fall was an important step in the progress of English liberty.

**STAR-FISHES**, the name collectively applied to at least two well-marked orders of the class Echinodermata, these orders being respectively named Asteroidea and Ophiuroidea. In the first of these orders the Common Star-fishes are included, the latter group embracing those forms known popularly as 'Brittle-stars' and 'Sand-stars.' In the Asteroidea or True Star-fishes the body is star-shaped or may exhibit a five-sided or pentagonal form. A central disc forms the body proper, and from this disc five or more 'arms' radiate. These arms in the true Star-fishes contain prolongations of the stomach and viscera, and this latter feature forms a distinguishing characteristic of these animals. The skin is strengthened by deposits of limy or calcareous matter, and is itself of coriaceous or leathery consistence. The mouth, which is placed on the lower or inferior extremity of the body, is not provided with teeth as in the nearly-allied Sea-urchins or Echini, and an anal opening or vent either exists on the dorsal surface of the body, or is entirely wanting. The so-called *skeleton* of the Star-fishes consists of numbers of limy plates termed *ossicula*, which are united together by the leathery skin, and form a kind of pliant internal armour, which at once serves to support as well as to strengthen the softer and inclosed parts. In the arm or ray of a star-fish the skeleton is seen to be composed, firstly, of a double series of plates named *ambulacral ossicles*, which form the floor of the ray, and which are united by their extremities and form a groove, named the *ambulacral groove*, in which the *ambulacra* or little *tubular feet*,

to be presently alluded to, are situated. At their outer sides the ambulacral ossicles articulate with other limy pieces, named *adambulacral plates*, and these latter are in turn connected to the plates forming the general support of the arms. The outer surface in the Star-fishes exhibits those peculiar little organisms named *Pedicellariae*, supposed by some authorities to be parasitic in their nature, and by others to represent modified spines. (See *PEDICELLARIAE*.) In their internal organization the asteroids exhibit a digestive system consisting of the central mouth, and of a large stomach which sends a pair of sac-like pouches into each ray. An intestine may be present or not, and (as in the genera *Luidia*, *Astropecten*, &c.) no anus exist. The heart is represented in these animals by two circular blood-vessels, connected by a tubular structure; one of the circular vessels encircling the gullet, whilst the other surrounds the intestine. From the circular vessels others radiate to supply the various parts of the body. No specialized breathing-organs exist, but it is highly probable that the membrane or *mesentery* which lines and supports the viscera of the body, and which is richly provided with *cilia* or vibratile filaments, may subserve respiration. Water may be admitted to the general body-cavity by means of ciliated tubes opening on the outer surface of the body, this fluid being used in respiration. The nervous system in the Star-fishes is arranged in a radial manner like the other systems of the body, and consists of a gangliated cord of nervous matter surrounding the mouth, and giving off five chief filaments, one of which passes to supply each ray. Organs of sense are represented by *eyes* or *ocelli*, consisting of pigment spots situated at the tips of the rays, and which may exercise a visual function. These structures are often covered by movable spines, constituting the so-called *cyclids* of these forms. The *ambulacral* or locomotive system of the Star-fishes forms a characteristic feature of these animals, as of all other Echinodermata. This system consists primarily of rows of contractile tubular feet, named *ambulacra*, which are provided with suckers at their extremities, and which are situated in rows in the *ambulacral grooves*, already described as existing on the under surface of the rays in the Star-fishes. These feet may be well seen by placing a living star-fish in a clear glass vessel, and watching it crawl up the sides of its abode. Each groove thus tapers towards the extremity of its ray, and along the floor of the groove, and externally to the *ambulacral ossicles*, a main tube or ambulacral vessel conveying water to the tube-feet is situated. At the attached end of each little tube-foot where it springs from the ambulacral vessel, a little contractile sac exists, and the ambulacral vessels themselves originate from a central vessel surrounding the mouth. Water is admitted from without to the central vessel, through a tube termed the *sand-canal*, which opens externally on the dorsal or upper surface of the star-fish in one or more perforated plates which may readily be distinguished in all Star-fishes, and to which the name of *madreporiform plates* is given. The perforated structure of these plates is adapted for admitting water, and excluding at the same time particles of sand and extraneous matters. When the star-fishes move about, they do so by inflating the tube-feet with water conveyed to them by the ambulacral vessels, the effect of this fluid being to render the tube-feet stiff and tense, so that their suckers can readily be protruded and applied to any surface to which the creatures wish to adhere. Retraction of the feet is effected by the water being sent back into the vessels by the contraction of the feet, whilst some observers maintain that the fluid may escape externally from the feet through the

perforation or aperture in the suckers. The reproductive organs exist in the form of pairs of branching tubes seen in each ray. The young undergo a metamorphosis, and the perfect form is developed from only a part of the larva or embryo in some cases. The embryo of the Star-fishes, unlike that of the Sea-urchins, does not develop any continuous internal skeleton. As in other Echinodermata, the young form appears of a bilateral or two-sided form, and is thus unlike the radial shape of the adult. In some cases the young larva was formerly described under such names as *Bipinnaria*, &c., and was thought to be an entirely different animal from the Star-fish. The form of the body in the Star-fishes varies very much. The shape of the Common Five-rayed Star or Cross Fish (*Uraster rubens*) is very familiar to every seaside visitor; the central disc being small and the rays elongated. Like other star-fishes, the common species is able to reproduce lost or injured parts, and star-fishes may be frequently met with showing new or budding arms in all stages of development. The genus *Asterias* includes several very familiar species (for example, *A. aurantiacea*, &c.), and is known by having a star-shaped symmetrical body, with two rows of tube-feet in each groove. *Cribella* is another well-known genus, with five rays covered with spiny tubercles, and with the grooves edged with spines. *Cribella oculata*, the Eyed Cribella, is a well-known form, with blunt rays, and an indefinitely-shaped disc. The genus *Asterina* has the body covered with short spines on both surfaces, and of discoid shape, the rays being connected together by membrane. *A. gibbosa*, the Gibbous Starlet, is a familiar species. The *Solaster*, or 'Sun Stars,' are so named from the large round body disc with their numerous short rays (twelve to fifteen in number), covered with tufts of spines. *Solaster papposa*, the Common Sun-star, is a familiar species. In the genus *Goniaster*, or that of the 'Cushion-stars,' in which the regular star shape of the body is replaced by a pentagonal disc, the form of the disc and rays is best seen on the lower surface of the body. The Knotty Cushion-star (*Goniaster equestris*) possesses the rays thick and rounded, and the body of a general conical form. In *Palmipes*, of which genus *P. membranaceus*, or the Bird's Foot Sea-star is a familiar species, the body is flattened, is of thin structure, and is covered with small tufts of spines. It is interesting to note that the food of most star-fishes consists of animal matter, such as whelks, crabs, and allied forms. The Star-fishes were long supposed to open such bivalves as mussels and oysters by inserting one of their rays between the shells. But apart from the obvious impossibility of the procedure, this theory of the attack on the well-protected mollusc is untenable. It is probable from observations, which may be repeated by every seaside visitor, that the Star-fishes attack these and other molluscs, by everting their stomachs, and irritating or killing the animal by the acrid secretion of the everted viscus, the secretion being smeared over the shell opening, in which case the mollusc is forced to uncloose its valves, or is altogether at the mercy of the star-fish.

The second order of Star-fishes—that of the Ophiuroidea—includes those forms in which the stomach and other viscera are confined to the central body disc, which is sharply defined from the arms or rays, the latter being mere appendages to the body in this case, and not forming actual parts of it as in the true Star-fishes. In the Brittle-stars and Sand-stars we therefore find the body to consist of a disc or rounded structure, destitute of pedicellariae, but covered with scales, plates, or granules, whilst the arms are enclosed in four rows of limy plates, the side plates carrying spines. The mouth is furnished with a

dental apparatus, and also with tentacular filaments. No anal aperture exists, efferent matters being rejected from the stomach by the mouth; and no diverticula or appendages are borne by the stomach, as in the true Star-fishes. The arms in the Ophiuroidea constitute the locomotive organs, these appendages being rapidly and easily moved about. An ambulacral system undoubtedly exists in the Ophiuroidea, but whether or not it is in communication with the exterior of the body is a matter of doubt. The feet are not at any rate provided with suckers as in the true Star-fishes, and they do not originate from contractile sacs or vesicles as in the latter forms. The embryos in the Ophiuroidea are provided with an endoskeleton, and the body of the future form is developed at an early period from the *pseud-embryo* as the larva is named. This group of Star-fishes may be conveniently divided into two divisions. The Ophiuroidea thus possess five arms, which are invariably of simple structure, and the genital fissures number two or four. To this group belong the well-known genera *Ophiura* and *Ophiocoma*. The former includes the *O. texturata*, or Common Sand-star, dredged often in great numbers in sandy localities, and the *O. albida*, or White Sand-star. In this genus the rays are scaly, and have large shield-like plates at their origin. The *Ophiocoma* or Brittle-stars—of which genus *O. neglecta*, the Gray Brittle-star, and *O. rosula*, the Common Brittle-star, are familiar species—are very curious forms, deriving their popular name from their habit of breaking off their arms on the slightest touch or contact. *Luidia* is another well-known genus, of which *L. fragilissima* is a familiar example. The second group of the Ophiuroidea is that of the *Asterophydia*, in which the genital openings number ten, and the arms may be simple, but are more usually branched. In the genus *Asterophyton*, represented by *A. scutatum*, the Shetland Argus or Medusa Head-star, the arms divide in two near their bases; each division exhibiting a subdivision into very many smaller branches which intertwine in the most complicated manner. *A. verrucosum* of the Indian Ocean is another species, whilst *A. arborescens* inhabits the Mediterranean Sea. These latter forms are sometimes included in the group *Euryalina*. The Rosy Feather Star (*Comatulula (Antedon) roseacea*) is not a true star-fish, but belongs to the order Crinoidea, or that of the Encrinites and Lily Stars. It spends the early part of its life in a rooted and stalked condition, but breaks away from its stalk and appears latterly as a free star-fish, possessing ten arms fringed with processes or cirri, and which the animal uses to creep about with. The True Star-fishes or Asteroidea are first represented in a fossil state in the Lower Silurian Rocks, the chief genera being *Palæaster*, *Stenaster*, *Palæocoma*, and *Palæodiscus*. In the Oolitic series they are also abundant (*Uraster*, *Luidia*, &c.); in the chalk *Oreaster* and *Stellaster* are the best known genera; and in the Eocene formations the living genera *Goniaster* and *Astroperten* are represented in a fossil state. The Ophiuroids first appear in the Upper Silurian rocks (*Protaster Sedgwickii*). In the Triassic rocks the *Aspidura lorica* (Goldfuss) occurs; and in Cretaceous, as well as Tertiary strata, the Brittle and Sand Stars are tolerably well represented. *Ophiotepis*, *Ophiocoma*, *Ophioderma*, and *Acroua* are familiar genera from Mesozoic rocks.

STARGARD (Neu-), a town in Prussia, in the province of Pomerania, in the government, and 21 miles S.E. of the town of Stettin, in a pleasant and fertile district, on the left bank of the Ihna, which is here navigable. It consists of the town proper, and of two suburbs. Besides churches it has an ancient town-house, a gymnasium, nursery for fruit-trees, and an orphan asylum; is the seat of a

court of law and several public offices, and has manufactures of leather, woollen and linen cloth, hosiery, hats, soap, and tobacco. Pop. (1900), 26,858.

STAR-GAZER (*Anableps tetraphthalmus*), a Teleostean fish included in the family Cyprinodontidae, a group nearly allied to the Carp family (Cyprinidae). This genus is distinguished by the presence of teeth in its palate, by the head being flattened between the eyes, and by the nostrils being of tubular conformation. But the character of distinctive importance in these fishes is that afforded by the apparently divided eyes; each eye presenting the appearance of being divided into two distinct organs. This appearance, however, is produced merely by the presence of an opaque band dividing the cornea of each eye in a transverse manner; the iris (see EYE) also sending out two projecting parts which unite beneath the band dividing the cornea. The lens of the eye, which in these fishes is of very prominent form, is pear-shaped; its broad extremity being situated under the large segment or half of the cornea. The Star-gazer is found in the rivers of Surinam. It produces its young alive, and is therefore an ovo-viviparous fish. Two other allied species are known to zoologists.

The name *Sky-gazer* or *Star-gazer* is also given to a different genus of Teleostean Fishes from the preceding—namely, the genus *Uranoscopus*, of which genus the *U. scaber* is a well-known form. This species inhabits the Mediterranean, and derives its scientific name from the position of the eyes, which are set on the upper aspect of the head, instead of at the sides, as is generally the case in fishes. This fish lives in deep waters, and is said to angle for smaller fishes by means of a slender filament or *barbule* attached to the mouth. The flesh is palatable, and is eaten on the Mediterranean coasts.

STARLING (*Sturnus*), a genus of Insectorial Birds, belonging to the family Sturnidae, of the Conirostral section of the order. This family is known by the compressed bill, the long and pointed wings, and the short tail. The tarsi are stout, and covered in front with broad scales. The toes are also elongated and strong, the hinder toe being largely developed. The nostrils are placed in membranous grooves. The sub-family Sturninae includes the Starling genus itself and the Pastors. The Starlings are known as a genus by the sharp straight bill, by the second quill of the wings being the longest, the first quill being rudimentary. The groove of the nostrils is conical and feathered. The Common Starling (*Sturnus vulgaris*, ORNITHOLOGY, Pl. III., fig. 9) is a well-known British bird, which is commonly seen congregated together in large flocks, particularly in marshy districts. The general colour is a dark or blackish green, tinted with purple hues, and with metallic lustres. The shoulders are brown or buff, the wing-coverts being edged with pale brown, and the general plumage spotted with buff. The breast feathers are elongated and pointed; the beak is coloured yellow. In the second year of life the characteristic colours consist of the adult colours just described, these, however, being of generally lighter hue, whilst the general surface is marked with light-coloured spots. The first year's birds are coloured brown or brownish gray. The females are less brilliantly coloured than the males. The nest is loosely constructed, and is generally found in some ruined wall or castle, or in a hollow tree. The eggs, numbering five, are coloured of a very pale blue. The young are tended by both parents, and when full grown aid in swelling the numbers of the large flocks. The food consists of insects, and these birds haunt domestic animals apparently for the purpose of securing the insects that prey upon them. They thus

perch on the backs of cattle in search of the insect larvae that burrow in the skin; and from sheep these birds may be seen to steal wool for the purpose of lining the nest. Molluscs, worms, and vegetable matters may also form part of the Starling's dietary; and not unfrequently these birds have been known to strip whole shrubberies of their leaves. The Common Starling occurs throughout Europe, in Africa from the north to the Cape of Good Hope, and in eastern Asia and Japan. These birds appear to migrate southwards in autumn, about the end of September, or sooner in some cases. They are viewed with great favour in many districts, and may be taught to speak, to mimic sounds with great distinctness, and to whistle tunes. An allied species is the *Sturnus unicolor*, which seems to be peculiar to Sardinia. The Rose-coloured Pastor (*P. roseus*) of Asia and Africa, and which migrates to Europe, is another allied genus. The Red-winged Starling (*Agelaius phoeniceus*) belongs to the nearly related sub-family Agelaiina. The bill is flattened at the base; the wings have their second and third quills longest; and the tail is long and rounded. This bird is American in its distribution, and commits much havoc in the fields of young Indian-corn. The male is coloured glossy black, with the wing-coverts reddish-brown and scarlet. The female is coloured black, the feathers being edged with light brown. The chin is light brown with reddish hues; and two light stripes dotted with black extend over the eyes from the nostrils, and from the lower jaw across the head. The average length of the male is 9 and of the female 7 inches. The nest is built amongst grass and reeds, and the eggs, numbering five, are a pale-blue colour. The male seeks to distract intruders from the nest by feigning lameness and by uttering shrill cries.

STAR-NOSED MOLE. See MOLE.

STARODOUB, a town in Russia, in the government of Czernigov, and 97 miles north-east of Czernigov. It has manufactures of leather and copper-ware; a bell-foundry; and an active trade with St. Petersburg and Riga in hemp, hemp-oil, tallow, mats, corn, brandy, honey, and wax. Pop. (1894), 25,517.

STAR OF BETHLEHEM (*Ornithogalum umbellatum*; natural order Liliaceae). This plant is sometimes called *eleven o'clock*, from the circumstance of the flowers opening at about that time in the morning. The root is a bulb; the leaves are linear, and all radical; the stem 6 or 8 inches high and terminated by a corymb of six or eight white and star-like flowers: these last are very evanescent, and close four or five hours after expansion. The plant grows wild in Europe, and is much cultivated in gardens for ornament.

STAR OF INDIA, an order of knighthood instituted in 1861, and enlarged in 1866. It is usually conferred on distinguished Indian subjects of the queen, or military, naval, or civil officers who have rendered important services to the Indian Empire. The complete designation of the order is 'The most exalted order of the Star of India.' It consists, when it has its full complement, of the sovereign, a grand-master (G.M.S.I.), who is always the viceroy and governor-general of India for the time being, twenty-five knights grand commanders (G.C.S.I.), fifty knights commanders (K.C.S.I.), and a hundred companions (C.S.I.), besides extra and honorary knights grand commanders, and knights commanders. The insignia of the order are a collar, badge, and star. The collar consists of a double chain of gold, bearing the heraldic rose of England, two palm branches crossed and tied with a ribbon, and a lotus-flower repeated several times in succession, with an imperial crown at the lower part of the collar. All the

ornaments are of enamelled gold. The badge is suspended from the imperial crown in the collar, and consists of a five-pointed star, with an oval medallion attached, having for the centre an onyx cameo profile bust of Queen Victoria, and for the border a strip of blue enamel, on which is written in gold letters the motto of the order, 'Heaven's light our guide.' The investment badge is similar to that suspended from the collar, but has the star, the setting of the cameo, and the motto all of diamonds. It is worn pendent from a sky-blue ribbon with a white stripe near either edge. The star of the order is a five-pointed star of diamonds set in an irradiated field of gold, surrounded by an azure belt bearing in diamonds the motto of the order, and having all round it wavy rays of gold.

STAROSTE, in Poland, those noblemen who were reckoned among the dignitaries of the land (*dignitarii terrarum*), and who received a castle or landed estate from the crown domains (*mensa regia*). The starosty was granted only for the life of the occupant, on whose death, however, the king was obliged to grant it anew. Some of the starosts had civil and criminal jurisdiction over a certain district (*grod*), others (*tentuarii*) merely enjoyed the revenues of the starosty.

STARVATION, the name applied in physiology to the effects produced by *inanition* or the want of proper food and nutriment. The phenomena of starvation present subjects of great interest to the medical practitioner from their obvious bearing upon phenomena induced through the inability to take nourishment occasioned by some diseases. As studied by a French experimentalist, M. Chossat (Gaz. Méd. de Paris, October, 1843), the symptoms which intervene in starvation are at first marked by a very rapid diminution in the weight of the body; this decrease, however, becoming of more gradual kind as the period of death approaches. A striking uniformity is found between the time or period at which death results from starvation and the loss of weight experienced. Thus Chossat found that in different warm-blooded animals death resulted when the body had lost about 40 per cent., or two-fifths of its original and normal weight. Great variations undoubtedly existed in the extremes of Chossat's cases; the circumstances which seem most powerfully to have affected these results being the amount of fat contained in the body prior to the commencement of the starvation period. The animals which had most fat stored up lost weight quickest, and at the same time lived longest. A well-known case of starvation is recorded, in which a fat pig, through a landslip at Dover, was buried alive in its sty for 160 days. Being then dug out, the animal was found to weigh only 40 lbs., its original weight being 160 lbs. It had thus lost 75 per cent. of its weight; and the fact of its prolonged existence must be held to be due to its being maintained through the absorption of its fat. Analogous instances to this are seen in the natural phenomena of hibernation; where, as in the case of the Bears and other forms, the fat accumulated in summer is absorbed during their winter-sleep and torpor. Chossat found that in animals undergoing starvation the symptoms observed during the first half or two-thirds of the period are those of calmness and quietness; the temperature (to be presently noted) then becoming elevated, restlessness and agitation prevails; and when life is terminated by the rapid fall of the temperature stupor supervenes. The extremities become cold and weak, and are finally unable to support the weight of the body; whilst the pupils of the eyes become dilated; and occasionally at death convulsive twitchings may be present. The excrement or faecal matters are small

in quantity after those which are voided as the result of the food last partaken of; and consist chiefly of greenish matters probably derived from the biliary secretions. At death the faeces become watery, and are found in addition to contain saline matters. The body loses weight at different rates in its different parts. They may be divided into those parts which lose more, and those which at death lose less than 40 per cent. of their original substance. Thus those which lose less are the *muscular coat of stomach* (which loses 39·7 per cent.); the *pharynx and oesophagus* (34·2); *skin* (33·3); *kidneys* (31·9); *lungs, &c.* (22·2); *skeleton* (16·7); *eyes* (10·0); and *nervous system* (1·9). The parts which lose more than 40 per cent. are the *fats* (93·3); *blood* (75·0); *spleen* (71·4); *pancreas* (64·1); *liver* (52·0); *heart* (44·8); *intestines* (42·4); and *locomotive muscles* (42·3). Thus it will be seen that the fatty matters are almost entirely removed by starvation; and the blood loses three-fourths of its original amount. It is probable that the total nutritive powers of the body during starvation go to nourish the nervous tissues, the loss of which is seen to be very small from the foregoing table; whilst, as will be duly considered, the true mode of death from starvation appears to be death from want of heat; the body being preserved alive, notwithstanding the want of fresh nutritive material, by the combustion or absorption of the fatty matters it contains. Chossat also found that proportionally to the more active nutrition and waste in young animals, such died sooner from starvation than older forms; and he also determined the equally important fact that if young animals especially are supplied with an *insufficient* amount of food, they succumb as if they were actually starved; the process of starvation being of necessity more gradual in the latter instance. The mere variations in the temperature observed by Chossat, and already alluded to, formed more prominent points of note in his observations than the actual decrease of heat. It fluctuated or varied daily, in some cases, some 5° and 6° Fahr. instead of 1° and 2° Fahr., as observed in the normal and healthy state of the body. In the human subject the *symptoms* of starvation have been closely studied by physiologists, with the effect of determining a stated order in their appearance and effects. The preliminary hunger appears to be accompanied in the first instance by severe pain in the stomach and epigastric region generally. The thirst becomes intense, and although undoubtedly in man the want of water induces death at a much earlier period than where drink is attainable by lower forms (for example birds), the want of water may in reality make comparatively little difference in the invasion of the fatal period. Sleeplessness appears to be early manifested; the severe pain at first felt in the stomach gradually ceasing. A characteristic feeling of sinking and weakness is described as occurring in the epigastric region; the thirst still continuing to an agonizing degree. The face assumes meanwhile an anxious, pale, and cachectic expression; the eyes are wild and staring; and the whole countenance, together with the entire body, participate in the rapid general emaciation which appears. The body latterly exhales a fœtid odour; the breath and lung secretions become also strong smelling; and the skin is said to become covered with a brown secretion—these results, doubtless, arising from the decomposition and organic decay of the tissues. The gait totters; the mind becomes impaired, delirium or convulsions may ensue, and death occurs, with or without the accompaniment of diarrhoea. The *post-mortem* examination in cases of starvation reveals a state of *anæmia* or *bloodlessness* in all parts of the body save in the brain,

which appears to the last to receive a due supply of blood. The fat is entirely wanting; and the various organs and tissues have undergone a marked diminution in bulk. The coats of the *small intestine* are seen to be exceedingly thin, this appearance being almost characteristic of death by starvation. The gall-bladder generally contains much bile, and the body goes more rapidly to decay than after death from ordinary causes.

The subject of starvation, as has already been remarked, relates itself in a very marked and important manner to the questions of *abstinence* in diet, and mediately through the latter point to that of abstinence from various or particular kinds of food. Thus a sudden and unfavourable change in the dietary of prisoners or paupers may induce, in virtue of the new food containing a low percentage of certain nutritive matters, symptoms analogous to those of starvation. This fact was well exemplified in the case of the convicts at Millbank Prison in 1823, when out of 860 prisoners 437 were seized with symptoms of diarrhoea, dysentery, diminution of flesh and strength, delirium and mania, &c., in consequence of their rations being unwarrantably and suddenly reduced below the average and necessary amount. At times the convicts were similarly seized from prolonged insufficiency of diet; the surrounding conditions of air, light, and heat being as of old when health prevailed along with a proper dietary. Want of nutriment produces, as a noted effect, an incapacity for the *digestion* of whatever amount is supplied. This result is probably due to nervous causes; and primarily perhaps to the want of stimulation of the appetite through the insufficient secretion of the gastric juice.

Several interesting cases are on record which assist us in forming an idea of the extent to which human life may be prolonged without food. Where the *temperature* of the body is maintained in tolerable efficiency, life may be prolonged for very long periods without food; a state of syncope prevailing—as in several noted cases of so called *apparent death*. Decrease of temperature, in short, is the chief condition on which the actual termination of life in cases of starvation depends. And conversely, it was found by Chossat that in the case of animals whose death seemed imminent from starvation, restoration took place primarily by the application of artificial heat. They thus manifested activity, and were able afterwards to partake of food. Whilst in other cases, in which food was taken and insufficient attention paid to the temperature of the body, death resulted. From eight to ten days is stated as the usual period during which human life can be supported without food or drink. If water be given this period may be greatly exceeded, and where a moist condition of the atmosphere exists life may for the same reason be prolonged. A case is recorded in which some workmen were dug out alive after fourteen days' confinement in a cold damp vault; and another is mentioned in which a miner was extricated alive after being shut up in a mine for twenty-three days, during the first ten of which he subsisted on a little dirty water. He died, however, three days after his release. Life has been prolonged for sixty days in a person suffering from religious mania, who abstained from food, and supported his existence by sucking an orange. In some remarkable cases of nervous hysteria and other diseased conditions no food may be taken, and yet the body may be perfectly sustained. The system is disposed to or becomes inured to the abstinence, just as under other conditions it exhibits a want of susceptibility to the ordinary effects of certain medicines, &c. All other cases—such as those of '*fasting girls*'—of reported

total abstinence from food (several of which have ended fatally from the patient being allowed to be watched by nurses) are to be regarded with great suspicion as probably cases of common imposition.

**STASSFURTHITE.** Stassfurth, near Magdeburg, is famed for its immense beds of salt and other alkaline minerals. Among these there is one which is peculiar to this locality, to which the name of Stassfurthite is given. This mineral consists of chloride and borate of magnesium, containing, on an average, 11 per cent. of magnesium chloride, 87·5 per cent. of magnesium borate, and 1·5 per cent. of water.

**STATEN ISLAND,** an island belonging to South America, off the south-east coast of Tierra-del-Fuego, extending 38 miles E.N.E. to W.S.W. between Cape St. John and Cape St. Bartholomew, and separated from the mainland by the Strait of Le Maire. Its surface is extremely mountainous and rugged, some of the summits rising to the height of 3000 feet, and usually retaining a covering of snow. It is densely covered with evergreens, beeches (the Antarctic beech) and other shrubs and plants, the vegetation of which is greatly promoted by the humidity of the climate. Few days pass without rain, and the low ground is in many places so swampy and boggy as to form a perfect quagmire. The temperature, though usually low, varies little throughout the year, and thunder and lightning are scarcely known. It contains several good harbours, but all more or less difficult of access, from the force with which the tides set across their mouths. The most eligible harbour for shelter is Port-Cook on the north-east coast.

**STATEN ISLAND,** an island included in Greater New York, some 11 miles to the south-west of the city proper, or Manhattan borough. It is separated from Long Island by the Narrows, which form the entrance to New York harbour, and from New Jersey by Staten Island Sound, about  $\frac{1}{2}$  mile broad. It constitutes the borough of Richmond, and is the most southern land belonging to New York. Its length is 14 miles, and its greatest breadth 8 miles. It contains numerous villages, and many elegant country seats; and has constant communication with New York by steam ferry-boats. Pop. (1890), 51,693. For further particulars see NEW YORK.

**STATES or ESTATES,** in politics sections of a community having common political privileges. In all European countries which have not absolute rulers, there were, after the introduction of representative government at first only two states in this sense of the term, the nobility and clergy. Gradually as the burgesses or inhabitants of towns acquired political rights they formed a third estate, celebrated in French history under the name of the *tiers état*. In Great Britain the nobility and the higher clergy have become merged into one estate (although still nominally two), and in other countries the peasantry have been added to the third estate. In Sweden, till recent times, the peasantry formed a fourth estate, having separate representation in the legislature. See **ESTATES OF THE REALM**.

**STATES-GENERAL** (French *Etats Généraux*), the name given in France till 1789 to the general assemblies of the deputies of the three orders of the nation, the clergy, nobility, and the third estate (*tiers état*). When peers were present it was not as forming a separate body but as the representatives of their order. The right of convoking the states belonged to the king, to the regent, or the lieutenant-general of the kingdom. There was nothing fixed as to the number of electors or deputies, nor as to the conditions entitling one to vote or to be elected. Every holder of a fief, even if a woman, was an elector, and often all those paying taxes were called

upon to vote. In certain localities the election was direct, each voter giving his suffrage aloud; in others electors were nominated to choose the deputies. The peasants and burgesses everywhere were required to vote in this manner. Sometimes the three orders deliberated together, sometimes separately; sometimes they were divided according to the provinces or governments which they represented, and sometimes into committees and bureaux. The votes of the states were given according to the orders composing them. Each deputy sent to the States-general carried with him what was called a *cahier*, that is, a statement of grievances compiled by the bailliwick that returned him, and when the deputies were assembled each order prepared a general *cahier* for itself out of the *cahiers* of the different deputies. The *cahiers* of the different orders were presented to the king, who before dissolving the assembly promised to redress the grievances complained of in them; but this promise was a mere form. With regard to taxation, however, it was a principle that without the consent of the estates, and especially of the third estate, on which the whole burden of taxation fell, no impost could be established. The States-general were first convoked in 1302 by Philip the Fair, who wished to obtain their aid in his quarrel with Pope Boniface VIII. They were so called in contradistinction to the states provincial (*états provinciaux*) which assembled as early as the thirteenth century in certain districts of France called *pays d'états*, and which administered local affairs and voted subsidies to the king. Even after the States-general had been created the kings of France often preferred to turn to these provincial assemblies for supplies, and therefore did not summon the States-general at all, and in 1614 the larger assembly met for the last time before the revolution. In 1789 the three orders met once more under this name, but the *tiers état* then assumed to itself the title of National Assembly, and that of States-general was never afterwards revived in France.

The name of States-general (Dutch, *De staten generaal*) is also given to the legislative assembly of the Kingdom of the Netherlands, in which there are also provincial states (*provinciale staten*) for local government.

**STATES OF THE CHURCH.** See **CHURCH, STATES OF THE**.

**STATICS.** See **MECHANICS**.

**STATIONERY OFFICE,** an office in London which contracts for the wholesale supply of writing materials to the government offices at home and abroad, and for the printing of reports and other matters laid before the House of Commons. It was established in 1786 by the Lords of the Treasury, in whose hands all appointments to it lie. There is a branch office in Dublin.

**STATIONS,** a name variously used in the Roman Catholic Church. In the early church it was applied to the Wednesday and Friday fasts, which terminated at three in the afternoon. It is still applied to certain places of peculiar sanctity, especially certain churches in Rome, which members of the Roman Catholic Church are enjoined to visit on particular days; and the name of Stations of the Cross is given to the halting-places in a devotional exercise that is practised in some localities in all Roman Catholic countries. The exercise is in commemoration of Christ's passion, and those engaged in it follow a particular route to some eminence surmounted by a calvary or small chapel, which forms its goal. Along this route, called the way of Calvary, there are various spots (eleven to fifteen in number), which are marked by pictures or bas-reliefs representing scenes in the passion, and at these spots the cele-

brants stop, and kneeling repeat certain prayers prescribed for the purpose. Those who cannot read repeat the Lord's prayer and Hail Mary!

**STATISTICS.** Statistics, in the sense of the word to which it owes its name (derived from the New Latin *statista*, a statesman), is the investigation and exposition, by means of numerical data, of the actual condition of states and nations in regard to their internal organization and foreign relations; but the name is now very generally applied to tabular or other statements of numerical information, having no connection with politics. Even in the first narrower sense statistics is divided into many branches, according to the matter with which it deals. Thus there are statistics of territory, of population, soil and agriculture, industry and commerce; intellectual, moral, social, and religious statistics; statistics of administration, finance, and military and naval affairs. The collection of statistics may have the object merely of ascertaining numbers, as is often the case with statistics collected for purely administrative purposes; or it may be undertaken with the view of learning what happens on an average of a great number of cases, as is the case of insurance statistics; or its object may be to detect the causes of phenomena that appear in the consideration of a great number of individual cases—such phenomena, for example, as the decline of a certain trade, the prevalence of a certain disease, &c. In the first case the only chance of error is in the collection of the statistics; in the second case error may also arise from not obtaining statistics sufficiently comprehensive to give a real average and eliminate the effect of chance; and in the third case error may be due not only to the neglect to make a sufficient number of observations to ascertain the exact nature of the phenomena to be investigated, but also to the overlooking of some of the circumstances under which the statistics were collected. By such oversight precisely those circumstances may be left out of account which constitute the essential difference between cases in which the phenomena in question do, and cases in which they do not occur. In all of these ways positive errors may be made in dealing with statistics; but what often renders statistics valueless, or greatly diminishes their value even when they lead to no positive error, is want of the scientific insight necessary to enable one to put the proper questions, or the impossibility of obtaining the statistical information that it is most desirable to possess.

After statistics have been collected, the next thing necessary is to arrange the material. The simplest and most usual method of arrangement is that of tabular statements; but this method is not always practicable, and must be replaced by or used along with that of written summaries. Sometimes other methods of recording statistics are applicable, which have the advantage of presenting the information in a clearer and more impressive manner. This is often done by the aid of diagrams consisting of parallel lines, showing the circumstances under which the statistics were collected, and curved lines showing the results; frequently also by variously coloured, tinted, or shaded maps.

In all civilized countries the collection of statistics forms an important part of the administrative duties. In some of the larger states there is a special department of the government for the direction and supervision of statistics. The first country to possess an institution of this nature was Belgium, where it has existed since 1841. The labours of Quetelet have raised the reputation of the Belgian statistical bureau to a high pitch. In Great Britain there is as yet no such government department; but the board of trade

is intrusted with the collection and publication of a variety of statistical information relating chiefly to Great Britain and her colonies, but also in part to foreign countries; and it is open to any member of Parliament to move for what returns he pleases, and such motions are usually acceded to. In connection with the statistics of this country William Farr has rendered similar services to those which have been rendered to Belgium by Quetelet. The statistical reports of the French government departments are specially valuable on account of their breadth of scope and clearness of arrangement. Since 1862 there has existed at Berlin a statistical seminary for the training of officials for collecting statistics, and this example has been imitated elsewhere.

The name statistics was first used by a German of the name of Achenwall in 1749, but even before him authors had scientifically combined statistical materials, as Francesco Sansovino in Italy (1566); d'Avity in France (1621); Lucas de Linda in Holland (1655); Conring, Bose, and Beckmann and Gastel in Germany; and Salmon in England (1724). Among the most important of the English statistical works are Sir John Sinclair's *Statistical Account of Scotland* (twenty-one vols. 1791-99), G. R. Porter's *Progress of the Nation* (1836; new edition, 1851), M'Culloch's *Statistical Account of the British Empire* (1836; new edition, 1847), Macgregor's *Commercial Statistics* (1847), Tooke's *History of Prices* (six vols. 1838-57); J. E. Thorold Rogers's *History of Agriculture and Prices in England* (six vols. 1866-88); and his *Six Centuries of Work and Wages* (1885); Mulhall's *Dictionary of Statistics* (1900); and the *Statesman's Year-book*, an excellent and well-known annual publication. In recent years the science of statistics has occupied largely the attention of the public throughout the United Kingdom, and a vast array of statistical matter is now published by the British government in blue-books, &c. The Statistical Society of London, instituted in 1834, has rendered great services in the diffusion of useful knowledge on subjects of social and political economy, by the labours and investigations of its members, and the publication of the results of these in the society's Journal. The National Association for the Promotion of Social Science did much in this direction. Much has likewise been effected by the British Association for the Advancement of Science. The most important of the foreign periodicals devoted to statistics are the *Journal de la Société de Statistique de Paris*, and the *Zeitschrift des Königlichen Preussischen Statistischen Bureau*.

**STATIUS, PUBLIUS PAPINIUS**, a Roman epic poet, born at Naples in the reign of the Emperor Nero (about A.D. 61), and educated by his father, a rhetorician. His principal productions are two epic poems—the *Thebais*, in twelve books, treating of the war of the seven princes against Thebes; and the *Achilleis*, in two books, relating the achievements of Achilles, and incidents in his life previous to the Trojan war. The latter is unfinished. The style of Statius is bombastic and affected, often exhibiting the art of the declaimer rather than that of the poet; but he attracted general admiration in his own time, and even some modern critics have considered him inferior only to Virgil. He was a favourite in the middle ages, and is frequently mentioned and cited as an authority by Chaucer. He wrote some shorter poems, called *Silvæ*, which have been distributed into five books, and some of these compositions are eminently beautiful. Statius is supposed to have been destitute of fortune, and to have had to struggle against poverty until he was relieved, as he appears to have been, by the patronage of the Emperor Domitian, whom he flattered with unworthy servility.

He died about the hundredth year of the Christian era. A modern edition of the complete works of Statius is that of Queck (Leipzig, two vols., 1854); and of the Silvæ the best are those of Markland (London, 1728, 4to) and Sillig (Dresden, 1827).

STATOBLASTS. See POLYZOA.

STATUE. See SCULPTURE.

STATUTE, an act of the legislature of a state; a positive law. Statute is commonly applied to the acts of legislative bodies, consisting of representatives. Sometimes it is used to denote the whole body of acts passed in a single session of Parliament, and when two sessions have been held in the same year of a sovereign's reign the acts of the different sessions are distinguished as belonging to statutes 1 and 2 respectively. In monarchies not having representative bodies the acts of the sovereign are called *edicts*, *decrees*, *ordinances*, *rescripts*, and the same names are applied, even when there are representative bodies, to exercises of the royal prerogative independent of the legislature. Statutes are distinguished from common law. The latter owes its force to the principles of justice, to long use, and the consent of a nation; the former to a positive command or declaration of the supreme power. A statute is either public or private. The former must be taken account of by the courts, although not specially pleaded by any party claiming a privilege under them; while the courts are not bound to apply the latter unless specially pleaded. By 13 and 14 Vict. cap. xxi. s. 7 it is enacted that all acts passed after the commencement of the next session following the one in which that act was itself passed are to be considered public acts unless the contrary is expressly stated in the acts. Public acts are subdivided into general, local, and personal acts; private acts only into local and personal, all general acts being, in virtue of their nature, public. On another principle of division statutes are distinguished as declaratory, penal, and remedial. The first of these classes of statutes merely explain what the common law is when it has fallen into disuse, or become obscure as to its interpretation; the second class, namely, penal laws, impose punishments for violations of the law; and the third class, remedial laws, provide redress in cases where the law was defective, or abuses required correction. According to the rule now in force, established by 33 Geo. III. cap. xiii., a statute takes effect at the time when it receives the royal assent, unless some other date is fixed by the statute. In early times acts of Parliament were sometimes cited by the place where they were passed (as the statutes of Merton, Winchester, &c.); sometimes, like Papal bulls, by their initial words (as the statute *Quia emptores*, of the reign of Edward I.); and they are still sometimes cited according to their subject (as the Test Act, the Act of Conformity, the Universities (Scotland) Act, &c.) But since the reign of Edward II. the usual practice has been to cite them according to the year of the sovereign's reign in which the Parliament that passed them was held, and thus when the session of Parliament is divided by the date of the sovereign's accession, the acts of that session are cited by two years (2 and 3, 3 and 4, &c.) The several acts of one session are distinguished as different chapters. The oldest statute now extant is the Magna Charta, as confirmed in the 9th year of the reign of Henry III. The statutes belonging to the reigns of Henry III., Edward I., and Edward II. are called *vetera statuta* (old statutes), and those subsequently passed *nova statuta* (new statutes). Under the former designation are included various statutes 'of unknown date' (*incerti temporis*), so called because it is not known to which of the three reigns mentioned they belong. In the statute-book

are contained all the extant statutes from the ninth year of Henry III. to the present time, but among these are not included the enactments of the parliaments of the Commonwealth, which are styled ordinances. Of late years several steps have been taken towards classifying and consolidating the statute law, and various acts directed towards this end have been passed. Several works have been compiled for the purpose of presenting the statutes in a collected form. The first collective edition of the English acts of Parliament published by authority appeared in 1810-24, and covers the period down to the reign of Anne. In 1870-84 was published a revised edition of the statutes, a work extending to eighteen volumes and covering the period from 1235 to 1878. A second revised edition of the statutes, extending to sixteen volumes, and bringing them down to the year 1883, has since been issued, also an Index to Statutes in Force to 1901. Thus it is now comparatively easy to learn what statutes are repealed and what are in force.

STATUTE OF LIMITATIONS. See LIMITATIONS.

STAUBACH, FALL OF, a waterfall in Switzerland, in the canton of Berne, a little more than 6 miles in a straight line south by east of Interlaken, and about a mile from the village of Lauterbrunnen. It consists of a small stream of water, which falls without interruption from a height of about 900 feet. Before it reaches the bottom the resistance of the air converts it into a fine spray like dust (whence its name, signifying 'Dust-stream'). When seen in front it is described as resembling a magnificent transparent veil continually agitated by the wind. In the morning the rays of the sun form innumerable rainbows, which appear to move up and down over it.

STAUNTON, a town in the United States, capital of Augusta county, Virginia, in a fertile and well-cultivated district on Lewis Creek, 97 miles W.S.W. of Richmond. It is the seat of the western lunatic asylum and of the Virginia institution for the deaf and dumb and blind. In the limestone formation of the region surrounding Staunton are many extensive caverns, the most remarkable of which is Weyer's Cave, 18 miles to the north-east. Pop. (1890), 6975.

STAUNTON, HOWARD, celebrated as a Shaksperean editor and emendator, and pre-eminent as a chess-player, was born about 1810, and died in London on the 22d of June, 1874. He was educated at the University of Oxford, after leaving which he settled in London, and devoted himself to literary studies and pursuits, and to chess, which was with him something more than a pastime. It was as a chess-player that he first gained distinction, through his victory in 1843 in a match with St. Amant, at that time the champion of Europe. In the years immediately following he achieved even greater chess triumphs, and it is to chess that his first important publications belong. These were the Chess-player's Handbook (1847), the Chess-player's Companion and Chess-player's Text-book (1849); Chess Tournament (1852), containing the games played in the tournament of 1851. The Handbook and the Chess Praxis, subsequently published (1860) as a supplement to the Handbook, are by far the best compendiums of chess knowledge that had appeared in Great Britain down to their date. Before the appearance of this last chess work he had begun the publication of an important work in his favourite literary field, the drama of the Elizabethan age, with which, as well as with all the antiquarian knowledge that is necessary to throw light upon it, he was minutely familiar. This work was an edition of Shakspeare, which appeared between 1857 and 1860, and which was generally considered by the Shaksperian scholars of

the day to furnish the best text that had till then been published. From the time of the publication of this edition of Shakspeare's works he was much occupied with the study of the text of Shakspeare, with the view of issuing another edition of the same dramatist's works. This intention was, however, never fulfilled; but some of the results of his studies were given to the world in a series of papers on *Unsuspected Corruptions of Shakspeare's Text*, begun in the *Athenæum* in October, 1872, and continued to the time of his death. These papers exhibit a degree of conjectural sagacity combined with soberness of judgment scarcely matched in Shaksperian criticism. But these were not the only labours he found time for. He contributed largely to periodicals, published in 1865 a work on the Great Schools of England, and for many years before and up to his death acted as the editor of the chess column in the *Illustrated London News*. The *Theory and Practice of Chess*, by Staunton and Wormald, appeared in 1876.

**STAVANGER**, a seaport town in Norway, on an arm of the Bukkefjord, 105 miles north-west from Christiansand. It is one of the oldest towns in Norway, and has a remarkable ancient cathedral, dedicated to St. Swithin, one of the finest Gothic monuments in the country. It has some manufactures of earthenware and cloth, and several distilleries. It has a good harbour, and an active trade, chiefly in exporting herrings caught in the vicinity, as well as large quantities of lobsters and toraks, timber, and hides. Pop. (1900), 30,613.

**STAVOREN**, a seaport town in Holland, in the province of Friesland, 29 miles south-west from Leeuwarden, at the entrance to the Zuyder-Zee, formerly fortified. It is the oldest and was once the most important town in Friesland—a pre-eminence due to the energy of its inhabitants in prosecuting maritime trade, and especially to the boldness with which they showed the other western nations the practicability of entering the Baltic by way of the Sound; to the privileges it thus obtained; and to its position at the entrance to the Zuyder-Zee, across which, as late as A.D. 1230, a boat might be poled to Enkhuizen. It was also one of the oldest Hanse towns. It has now sunk to the position of an insignificant village. Pop. 662.

**STAVROPOL**, a government of Russia, in the general government of the Caucasus, bounded on the north by the government of Astrakhan and the land of the Don Cossacks, on the east by the Terek territory, on the south by the Terek and Kuban territories, and on the west by the Kuban territory. It consists mainly of arid steppes covered with salt lakes and marshes. The northern parts are periodically inundated by the Kalais and the Manych. A considerable trade is carried on in the government in salt, wool, and silk. The area since 1874, after the deduction of a portion that was in that year taken from it and added to the Terek territory, is 27,020 square miles. Pop. (1897), 873,863.

**STAVROPOL**, a Russian town (Caucasus), capital of the government of Stavropol, 307 miles south-west of Astrakhan, on the left bank of the Atchla, an affluent of the Kalais, in a fertile district. It consists of wide and well-formed streets; and has a fine bazaar, manufactures of soap and leather, and a considerable trade. Pop. (1897), 41,621.

**STAWELL**, a town in Australia, Victoria, 176 miles north-west of Melbourne, with which it is connected by rail. The public buildings include a town-hall, court-house, post and telegraph offices, several churches, mechanics' institute, theatre, and other buildings. It is the centre of the Pleasant Creek gold-field, and is best known on account of its rich quartz reefs. Pop. (1901), 5296.

**STAY**, a large, strong rope, extending from the upper end of each mast towards the stem of the ship, as the shrouds are extended on each side. The object of both is to prevent the masts from springing when the ship is pitching deep. *To stay* is to tack or bring the ship's head up to the wind for going about; hence to miss stays is to fail in the attempt to go about. *In stays or hove in stays* is the situation of a vessel when she is staying or in the act of going about.

**STAYS**. See **CORSET**.

**STEALING**. See **LARCENY**.

**STEAM**, in a technical sense, the vapour of water, generated by the application of heat. Steam is generated under a variety of aspects: it is seen to rise in great abundance from moist bodies when they are heated, forming white clouds, which diffuse themselves and disappear in the surrounding atmosphere. The air becomes loaded with invisible moisture in the condition of vapour intimately mixed with it. The visibility of the steam, in the first instance, arises from its contact and mixture with the colder air, by which it is partially condensed into vesicular particles. It is in this manner that clouds are formed. Simple steam is invisible, transparent, colourless. This is easily proved by the phenomena of the tea-kettle. If a tea-kettle boils violently, so that steam is formed and issues from the spout in great abundance, the steam is invisible at the orifice and for a little distance from it, and it is only after it has mingled to a greater or less degree with the air surrounding the current that it becomes visible—the visibility, in fact, being a consequence of the gradual conversion of the vapour into particles of condensed moisture, as already described. That the presence of air is the cause of the visibility is further proved by fitting to the spout of the kettle a glass tube, and causing the current of steam to pass through the tube. The vapour is perfectly invisible within the tube, and only becomes white and opaque, as before, after it emerges from the tube into the atmosphere.

When heat is first applied to water, as in a glass vessel over a strong lamp, where the phenomena of ebullition may be closely observed, a rapid effulgence of the fluid ensues. The water on the bottom being first heated and expanded, becomes lighter than the rest, rises to the top, and is replaced by a current of colder water descending, to receive in its turn a further accession of heat. Globules of steam are formed at the bottom, which rise and are condensed by the colder water, until, when the whole of the water has been raised to the boiling temperature, the globules freely ascend and escape from the surface of the water, forming volumes of steam rendered more or less visible. In this process the whole of the water may be boiled off or converted into steam. However rapidly the water may be boiled off, or however intense the heat that is applied, the temperature of the water after having reached to the boiling point, remains unaltered, so long as the vapour is free to escape into the open air. The permanence of the boiling point is one of the most remarkable of the phenomena of ebullition. This point is so well defined as in all civilized countries to furnish the standard for the comparison of temperature; it is the same on all thermometers, and is called the boiling point, which is numbered 212° on the Fahrenheit thermometer, 100° on the Centigrade, and 80° on the Réaumur thermometer. The temperature, besides being invariable, is also identical for the water and the steam which is generated from it.

Here it is necessary to state that steam is highly elastic: that is to say, it possesses a power of resistance to external pressure; and the steam which

is formed at 212° Fahrenheit possesses just that degree of elastic force which is required to balance and resist the pressure of the atmosphere. This pressure varies within certain restricted limits, but it is sufficient for the present to remark that the average pressure of the atmosphere at the level of the sea is equal to 14·7 lbs., or nearly 15 lbs. per square inch, and is measured by a barometrical column of mercury 29·92 inches, or nearly 30 inches high. Incipient vapour, then, is in course of formation in the water whilst its temperature is being elevated to the boiling point; and until it rises to 212° it is powerless to force its way into the air in a body. At 212° its elastic force is just equal to that of one atmosphere, or to 14·7 lbs. per square inch. Now, if by artificial means the pressure opposed to the discharge of steam from water be increased, water will no longer boil at 212°; its temperature will be raised to a higher degree, such that the force of the steam formed at this higher temperature will again just balance the resisting pressure. In fine, the higher the resisting pressure the higher to the same extent is the elastic force of the steam, and the higher the temperature at which it is formed. The rise of temperature that ensues on an increase of resistance to the escape of the steam is confirmed by a simple experiment. Take a strong glass flask, place water in it, and a thermometer in the water; and let it be held over a lamp until the water boils, whilst the thermometer is observed to be rising till it reaches 212°, when the steam will begin to escape rapidly from the neck of the flask. Let the flask now be corked tightly, and the heat continually applied; it will be observed that the disengagement of steam is almost entirely prevented, and that the thermometer does not now stand at 212°, but rises rapidly from that point up to 220° and 230°, showing that the free escape of the steam into the open air is necessary to the permanence of the boiling point. Let now the cork be suddenly pulled out of the neck of the flask; the vapour will instantly rush out in a large volume, and the thermometer will sink to 212°, showing that the excess of heat has been carried off by the steam, whilst the ebullition will be continued with the same rapidity as before the cork was inserted. Whilst the flask was closed by the cork, and the temperature of the water was raised, the tendency of the inclosed fluid to burst the vessel was very considerable. The earliest record of any experiment on the tensional force of a confined body of water exposed to heat is that which was published in 1663 by the Marquis of Worcester, who says:—'I have taken a piece of a whole cannon, whereof the end was burst, and filled it [with water] three-quarters full, stopping and screwing up the broken end, as also the touch-hole, and making a constant fire under it; within twenty-four hours it burst, and made a great crack.'

As at 212°, so at all other temperatures, the pressure of steam formed over water is always the same for the same temperature at which it is generated; and, conversely, steam formed under any given pressure, is invariably of the same temperature. This law of the formation of steam holds good for temperatures below 212° as well as for those above 212°; although, for the lower temperatures, the pressures must be correspondingly lower than that of the air. If the surface of the hot water be protected from the pressure of the air by being placed under a glass shade, and the air removed from it by means of an air-pump the water may be made to boil at all temperatures below 212°.

Another element in the constitution of steam is its density, which is expressed by the weight of 1 cubic foot of the steam. The density is naturally

increased as the pressure under which the steam is generated becomes more intense, for the particles of steam are more closely pressed together. The density of steam produced at 212° has been found by careful measurement, by M. Regnault, a celebrated French physicist, to be equal to ·038 lb. or  $\frac{1}{26}$  oz. per cubic foot, from which it follows that the volume of 1 lb. of such steam is equal to 26·36 cubic feet, which is nearly 1 cubic yard. Like the pressure or elastic force of steam, the density is invariably the same for a given temperature; and the remarkable conclusion is arrived at, that, for a given pressure, the temperature and the density are always the same, and that the same temperature, pressure, and density, are invariably associated.

Steam, when generated in the manner which has been assumed in the foregoing discussion, that is, in contact with water, is said to be saturated, and to be at its maximum density for its temperature, since it cannot take up, or assimilate to itself, more water, without at the same time, a rise of temperature. Steam may, of course, exist separately from water, and when thus isolated it may be superheated, or raised in temperature, when it acquires the properties of a perfect gas. Or, it may be reduced in temperature by cooling, when a portion of it is condensed, and becomes water, leaving the remainder of a lower density, and a lower pressure, corresponding to the reduced temperature. When thus treated the steam continues to be in the condition of saturation, just as if it had been generated direct from water.

The elastic force or pressure of steam is commonly expressed in pounds per square inch of area, of which 14·7 lbs., or, in round numbers, 15 lbs. on the square inch, are equal to one atmosphere of pressure, and the elastic force is occasionally expressed in 'atmospheres' of pressure, of which one, two, or three atmospheres would be equivalent, in round numbers, to 15 lbs., 30 lbs., and 45 lbs. per square inch.

Hitherto the sensible heat of steam only has been mentioned, measured by temperature. It was found that the higher the pressure of steam the higher also was its temperature; a fact which alone is sufficient to show that the heat expended in generating steam increases with the pressure. There is, however, a much greater expenditure of heat in generating steam from water than that which is indicated by, or sensible to the thermometer; in evidence of which it is sufficient to remark that, whilst the heat of a glowing fire is continuously absorbed by the contents of a boiling tea-kettle, the temperature remains steadily at 212°. The inflowing heat must, therefore, be appropriated and carried off by the outflowing steam in a 'latent' state; that is to say, in a condition which is not manifest to the sense of feeling or to the thermometer. All fluid bodies, whether liquid or gaseous, possess latent heat in various proportions. Water holds a large quantity. Ice at 32°, the freezing point, if melted into water at 32°, absorbs in the process as much heat as would raise the temperature of an equal weight of ice-cold water through 140°. Similarly, when water at 212° is converted into saturated steam of the same temperature,—under atmospheric pressure, of course,—it absorbs in the process of evaporation as much heat as would raise its temperature 965°, were it not converted into steam. The total heat of steam is therefore measured by 965°, added to the heat required to raise its temperature from the melting point of ice, 32°, to the boiling point, 212°; that is, through 180°. The latent heat is, indeed, more nearly 966°, on account of the slight variation in the specific heat of water. Thus the total heat of steam of one atmosphere is equal to 969° plus 180°, or 1149°. As the pressure and temperature

are increased, the latent heat is diminished, but the diminution of latent heat is less rapid than the rise of temperature; so that, upon the whole, the total heat of steam rises slowly with the temperature. Simple and obvious as the doctrine of latent heat may seem, it was a great discovery, the credit of which is due to Dr. Black, of Glasgow, who propounded the doctrine in 1762.

One pound of atmospheric saturated steam, it was said, has a volume equal to 26·36 cubic feet, which is 1642 times as great as the volume occupied by 1 lb. of water, about 28 cubic inches. James Watt was, therefore, nearly right when he concluded from his experiments that 1 cubic inch of water would form 1 cubic foot of atmospheric steam. He would have been exactly right, if the volume of a pound of such steam was 28 cubic feet, as against the volume of a pound of water, namely, 28 cubic inches. The 'relative volume,' as it is called, of atmospheric steam, is then 1642; being the number of times that the volume of the water from which it is generated is enlarged by evaporation. It is in virtue of such enlargement that the active force of steam becomes available in the steam-engine. The volume of an equal weight of steam diminishes as the pressure increases, and the relative volume is diminished in the same proportion.

The several properties of saturated steam, which have herein been announced, are exemplified in the annexed table; abstracted from the larger tables calculated by Mr. D. K. Clark.

Total Pressure per sq. Inch.	Temperature.	Total Heat.	Latent Heat.	Density or Weight of 1 Cubic Ft.	Volume of 1 Lb. of Steam.	Relative Volume of Steam.
Lbs.	Fahr.	Fahr.	Fahr.	Lb.	Cub. Ft.	Rel. Vol.
1	102·1	1112·5	1042·9	0·030	330·86	20,582
5	162·3	1180·3	1000·3	0·138	72·06	4,527
10	193·8	1140·3	978·4	0·264	37·84	2,358
14·7	212·0	1146·1	965·2	0·380	26·36	1,642
15	213·1	1146·4	964·8	0·387	25·85	1,610
20	228·0	1150·9	952·8	0·507	19·72	1,229
30	250·4	1157·8	937·9	0·743	13·46	838
40	267·3	1162·9	926·0	0·974	10·27	640
50	281·0	1167·1	916·3	1·202	8·31	518
60	292·7	1170·7	908·0	1·425	7·01	437
70	302·9	1173·8	900·8	1·648	6·07	378
80	312·0	1176·5	894·3	1·869	5·35	333
90	320·2	1179·1	888·5	2·089	4·79	298
100	327·9	1181·4	883·1	2·307	4·33	270
120	341·1	1185·4	873·7	2·738	3·65	227
140	352·9	1189·0	865·4	3·162	3·16	197
160	363·4	1192·2	857·9	3·590	2·79	174
180	372·9	1195·1	851·3	4·009	2·49	155
200	381·7	1197·8	845·0	4·431	2·26	141

From this table it is observable that the density of saturated steam increases rapidly, or, conversely, that its volume decreases rapidly, as the pressure is increased. For example, whilst steam of 15 lbs. pressure per square inch has a volume of about 26 cubic feet, the volume of steam of 30 lbs. per square inch is reduced to nearly a half, about 13½ cubic feet; of 60 lbs. steam, the volume is only 7 cubic feet, whilst of steam of three times this pressure the volume is but 2½ cubic feet. In the opposite direction, steam of a pressure less than atmospheric is much greater in volume. Steam of 5 lbs. pressure has a volume of 72½ cubic feet, and steam of 1 lb. pressure has a volume of 330½ cubic feet for 1 lb. of the steam.

We have hitherto considered the temperature and pressure of steam raised from pure water only, but when sea-water is employed we obtain very different results, according as it is more or less saturated with salt. The average specific gravity of sea water is from 1·029 to 1·030, at which it boils at the temperature of 213°·2. As the salt is not evaporated

with the steam, the water of course gradually increases in saturation and density; its boiling point, and consequently the temperature of the steam, continuing to rise in proportion. The following table gives the temperature of steam at the atmospheric pressure (or of the boiling point), for sea-water at different stages of saturation:—

Proportion of Salt in 100 Parts, by Weight.	Temp. Fahr.	Proportion of Salt in 100.	Temp. Fahr.
Common water, —	212°	Sea water, ....	212·2
Sea water, ..... 8·03	213·2	..... 24·25	221·4
" ..... 6·06	214·4	" ..... 27·28	222·5
" ..... 9·09	215·5	" ..... 30·30	223·7
" ..... 12·12	216·7	" ..... 33·34	224·9
" ..... 15·15	217·9	Saturated solution, .....	226·0
" ..... 18·18	219·0		

It is a singular fact that though low-pressure steam will scald most dreadfully, yet high-pressure steam will not. Dr. Thomson accounts for this as follows:—

'When the steam of boiling water comes in contact with any part of the living body it occasions a most severe scald, but when steam of a higher temperature than boiling water, or high-pressure steam as it is called, issues into the atmosphere, the finger, or any part of the body may be passed through it with impunity. It has not the property of scalding. And if a thermometer be placed into it we find the temperature greatly below that of boiling water.' 'When steam issues from the spout of a boiling tea-kettle it is at first invisible, and it is not till it has advanced some distance in the air that it begins to assume the appearance of a visible cloud. But condensed steam is visible the moment that it issues from the pipe. The high-pressure steam, supposing the elasticity double, occupies only half the space of low-pressure steam. The moment it comes into the atmosphere its volume is doubled. This occasions a prodigious increase in the capacity for heat, and at the same time mixes it with the cold atmospheric air. These two circumstances sink its temperature so low that it is no longer capable of scalding.'

It has already been stated that when the temperature of saturated steam is lowered, the pressure remaining the same, a portion of it is condensed. In general terms, it may be stated that when steam is brought into contact with bodies colder than itself, it is condensed, and returns to the condition of water. This process is known as condensation.

It must be added that steam is expansible in virtue of its elasticity; and that it expands, or enlarges in volume, in proportion as the resisting pressure by which it is confined, is reduced. In what ratio it expands, and what work is performed by expansion, are questions to be answered in the next article.

**STEAM-ENGINE.** The steam-engine is a heat engine, that is, a machine in which heat is employed to do mechanical work, the heat being the result of the more or less perfect combustion of some kind of fuel, such as coal, wood, or petroleum. The heat thus produced is partly utilized in generating steam, which is the working agent in steam-engines, the work being done by the pressure exerted by the steam upon a movable piston.

The expansive force of steam was known probably from the earliest times, and more was doubtless known about it to the ancients than has been generally admitted. Aristotle, Seneca, and other ancient writers accounted for earthquakes by the sudden conversion of water into steam, or 'air' as it was called, within the earth. This change, according to them, was effected by subterranean heat. Hero of Alexandria, in his work on Pneumatics, written more than 120 years before the Christian era, collected the

science and inventions of the ancients, along with some of his own, into a systematic treatise. Many of the inventions are ingenious; one of them is thus described, as a means of applying the force of steam issuing from a boiler to support a weight:—'A boiler,' he says, 'perforated on the top, is placed on the fire. From the perforation there proceeds a tube, on whose extremity is fixed a hollow hemisphere perforated in like manner. If then we place a light ball in the hemispherical cup it will follow that the vapour, rising up from the boiler through the tube, will support the sphere, and it will appear to dance.' In the year 130 B.C. Hero made an ingenious apparatus which was undoubtedly the first rotary steam-engine ever constructed. It consisted of a globular hollow vessel, having two jets projecting on opposite sides, the jets being directed in opposite directions tangentially to the vessel, which was supported on two bearings or trunnions at right angles to the plane of the jets. The steam was supplied through one of the trunnions from a boiler situated below, the rotary motion being obtained by the reaction caused by the steam as it escaped from the jets. This engine, which was in principle a reaction steam turbine, has been improved in modern times.

Passing over many centuries we come to Solomon de Caus, who was engineer and architect to Louis XIII., king of France, before the year 1612. In this year he entered the service of the elector-palatine, with whom he came to England; and in 1615 he published a work on the Rationale of Moving Forces, in which he appreciates the force of steam, 'because of the violence of the vapour which causes the water to rise'; and he enunciates in his fifth theorem that 'water will mount, by the help of fire, higher than its level'. He nearly fills a copper globe with water, which he places over a fire; the steam generated within the globe forces the water upwards through a vertical pipe which descends nearly to the bottom of the globe and rises to some height above it. The jet of water thus discharged rises to a considerable height. In 1629 Giovanni Branca directed a jet of steam from a boiler upon the vanes of a paddle-formed wheel; and he proposed to apply the power so obtained to the working of pestles and mortars for pounding materials for gun-powder, to raising water by buckets, and other applications. This appears to have been the first proposal to apply the elastic force of steam to useful purposes. With an important alteration in the form of the jet and in that of the vanes, the machine would resemble the efficient steam turbine of De Laval, which already competes in economy with the very best steam-engines of equal power. In 1663 the Marquis of Worcester published in his Century of Inventions a description of his 'admirable and most forcible way to drive up water by means of fire, which hath no bounder if the vessel be strong enough'—according to which we are to suppose a long upright pipe furnished at the top with a valve opening upwards and communicating with a vessel containing water. When steam is thrown upon the surface of the water it will force the water up to a height greater in proportion as the force of the steam exceeds the pressure of the atmosphere, the valve at the top of the pipe preventing the water from returning when the steam was cut off. 'One vessel rarefied by fire driveth up forty of cold water.' In his writings and prayers the marquis thanked God for showing him 'so great a secret of nature, beneficial to all mankind', yet he studiously withheld from mankind the construction of his 'semi-omnipotent power'; and he designed to have his machine buried with him, like a child wishing to

sleep with its toy. He appears to have judged very favourably of the credulity of his readers, as, for instance, when he expected them to believe that he had 'invented and perfected' a perpetual motion. The marquis, nevertheless, made his mark. About thirty years after his death, in 1667, Captain Thomas Savery (1699) described a condensing steam-engine (fig. 1) introduced by him for draining mines. He placed his engine at a height of

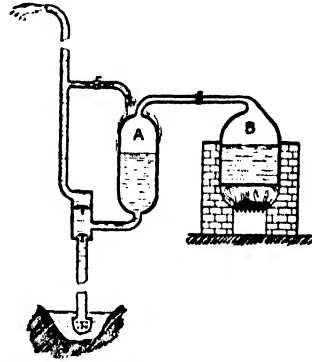


Fig. 1.—Savery's Pumping Engine.

between 20 and 30 feet above the level of the water. A large closed vessel A was filled with steam from a boiler B; this steam was reconverted, by cooling the outside of the vessel, into water, leaving the large space it had formerly occupied vacuum; into this vacuum water was raised, as into the vacuum of a common sucking-pump, by the pressure of the atmosphere. After this was accomplished the water was further raised by the elastic force of the steam admitted to and pressing directly upon the surface of the water collected into the vessel. In this description one reads the echo of previous inventions. The captain, however, improved upon all others by combining the principle of a vacuum by condensation with that of the elevation of water

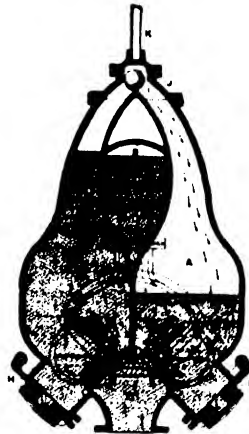


Fig. 2.

by high pressure. 'My engine,' he says, 'raises a full bore of water 60 or 70 feet high, and if strong enough I would raise you water 500 or 1000 feet high.' A great improvement on this apparatus has been made by Mr. C. H. Hall, who in 1872 invented the 'pulsometer' (fig. 2). It consists of an iron casing, with two chambers A A side by side, and meeting at a neck containing a ball-valve V, which admits steam alternately to either chamber. G G are the suction, and F F the delivery valves; K is the steam-pipe from the boiler, C the suction and D the discharge pipe; B is an air-vessel communicating with the delivery openings. Let it be assumed that steam is entering the right-hand chamber, and forcing out the water through the delivery-valve into the discharge-pipe D, at the same time water is

coming into the other chamber *A* from the suction-pipe *C*. As soon as all the water in the right-hand chamber has been forced through the delivery-valve, the ball-valve *I* is drawn over to the right-hand side, and there is a rapid condensation of the steam in this chamber. A partial vacuum is thus obtained, and the water rises, while at the same time steam is entering the left-hand chamber. The action is thus reversed and the operation goes on automatically, one vessel filling whilst the other is emptying. The consumption of steam, compared with the work done, is very great, but the apparatus is exceedingly simple, portable, and not liable to become choked with dirt, &c. It is much used in emergencies for draining water from flooded mines, &c. Dr. Denis Papin in 1690 proposed a scheme for producing a vacuum under a piston by steam. He had a cylinder containing a piston, below which he placed a fire so as to generate steam from a little water in the bottom of the cylinder. This steam raised the piston, which was secured in its elevated position by a catch; then the fire was removed, the steam condensed, and the piston released and forced down by the pressure of the atmosphere. This plan, though crude, contained the earliest suggestion of a vacuum under a piston by the agency of steam.

In the years 1705-1710 Thomas Newcomen and John Cawley, both of Dartmouth, constructed the well-known atmospheric steam-engine (fig. 8), from

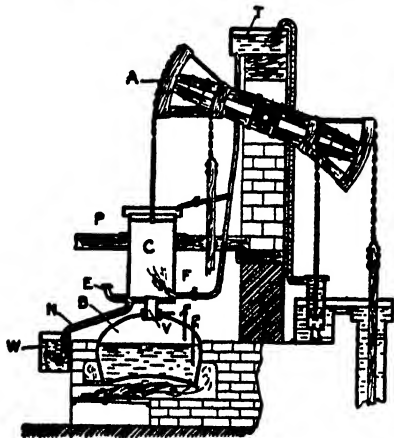


Fig. 8.—Newcomen's Atmospheric Engine.

which the growth of the modern steam-engine can be continuously and clearly traced. Newcomen and Cawley combined the good points of Savery and Papin—a separate boiler and furnace, and a separate cylinder and piston—with a distinct water-pump connected with the piston through the medium of an oscillating beam. It is scarcely possible to over-estimate the importance of the Newcomen engine, and the rapidity with which it was adopted as the most powerful and economical means then known for draining mines is shown from the fact recorded by Smeaton, that in 1767 there were 57 of these engines at work in the neighbourhood of Newcastle alone, with steam cylinders up to 75 inches in diameter. The working cylinder *C* was placed immediately over the boiler *B*, and was connected with it by a pipe provided with a stop-cock or valve *V*, by means of which the admission of steam to the cylinder was under control. The piston *P* was connected by a chain to one end of a working-beam *A*; the pump-rods in connection with the pump were attached in a similar manner

to the other end of the beam. The piston leaked considerably, and was therefore kept covered with water—a method of packing which, while it prevented the entry of air into the cylinder, necessitated the cylinder being vertical, and this in its turn entailed the use of the beam in order to adapt the engine for pumping. The weight of the pump-rods, &c., was sufficient to lift the piston to the top of the cylinder; steam was then admitted, so as to fill it and expel the air through a relief or snifting valve *Z*. The steam was then shut off and the relief-valve closed, and the injection-cock *X* opened, which allowed a spray of cold water from the tank *T* to enter the cylinder and condense the steam. A partial vacuum was produced, the pressure of the atmosphere forced the piston down and drew up the pump-rods, thus making a working stroke of the pump. The condensed steam and injection water was drained off from the bottom of the cylinder by a pipe *H*, leading to a feed-water tank *W*; the water from this tank was used to fill the boiler.

With respect to the discovery of the above-described method of effecting a rapid condensation of the steam in the cylinder, also a system of self-acting valves which were opened and closed by the reciprocations of the beam, without the usual agency of an attendant, Dr. Desaguliers gives the following concise account:—'They were surprised to see the engine go several strokes and very quick together, when after a search they found a hole in the piston which let the cold water in to condense the steam in the inside of the cylinder, whereas before they had always done it on the outside. They used before to work with a buoy in the cylinder inclosed in a pipe, which buoy rose when the steam was strong and opened the injection-pipe and made a stroke, whereby they were capable of giving only six, eight, or ten strokes in a minute, till a boy named Humphrey Potter, who attended the engine, added what he called a *scoggan*, by which the beam of the engine always opened and shut its own valves, and then it would go (entirely without the attendance of a man) fifteen or sixteen strokes in a minute. But this being perplexed with catches and strings, Mr. Henry Beighton, in an engine he had built at Newcastle-on-Tyne in 1718, took them all away, the beam itself supplying all much better.' For more than half a century the steam-engine, thus improved, remained in general use, without any material change. It was rightly named the atmospheric engine, as the actual moving power was the pressure of the atmosphere, whilst the steam was only instrumental in the production of a vacuum under the piston.

The engine of Newcomen was improved and enlarged by Smeaton; but even in Smeaton's hands the steam-engine was so imperfect that large quantities of fuel and steam were wasted in doing what was useless, namely, heating the cylinder, which was cooled and heated alternately for each stroke—by the cold water injected into it, and by the steam again admitted into it. The loss thus incurred amounted to more than one-half of the steam.

Under these conditions James Watt found the atmospheric engine, and he made the greatest improvements ever yet made on the steam-engine. At the time his attention was drawn to the subject he was a mathematical-instrument maker in Glasgow. He began his researches on the nature of steam as early as 1763, but his plans for improving the steam-engine seem not to have been matured until about 1768, and in the year following he obtained his first patent for 'methods of lessening the consumption of steam, and consequently of fuel, in fire-engines'. The great improvement held forth in the specification consists in condensing the steam, not in the

steam-cylinder, but in a separate vessel called a condenser, with which it was made to communicate at the right time by the opening of a valve. By this means the steam-cylinder was not cooled down by the injection of cold water at every condensation, as in the engine of Newcomen, and all the steam which was expended in heating the cylinder in Newcomen's engine was thus saved. He also specified his method of extracting the air and water from the condenser by means of pumps, and likewise the employment of high-pressure, or what he terms 'expansive', steam to work the engine, either with or without

condensation. In the same specification he also includes the rotatory engine to be applied to the turning of mills. Instead of rendering the piston air-tight by water on its upper surface, he proposes to effect this by means of oil, wax, tallow, &c. In 1781 one Steed obtained a patent for the crank motion, in order to convert the oscillatory motion of the beam into a continuous rotatory motion; but there is strong proof that the invention was stolen from Watt, as a pattern of the crank was lying in the yard of Boulton & Watt's foundry at Soho, for some time previous to the date of Steed's patent.

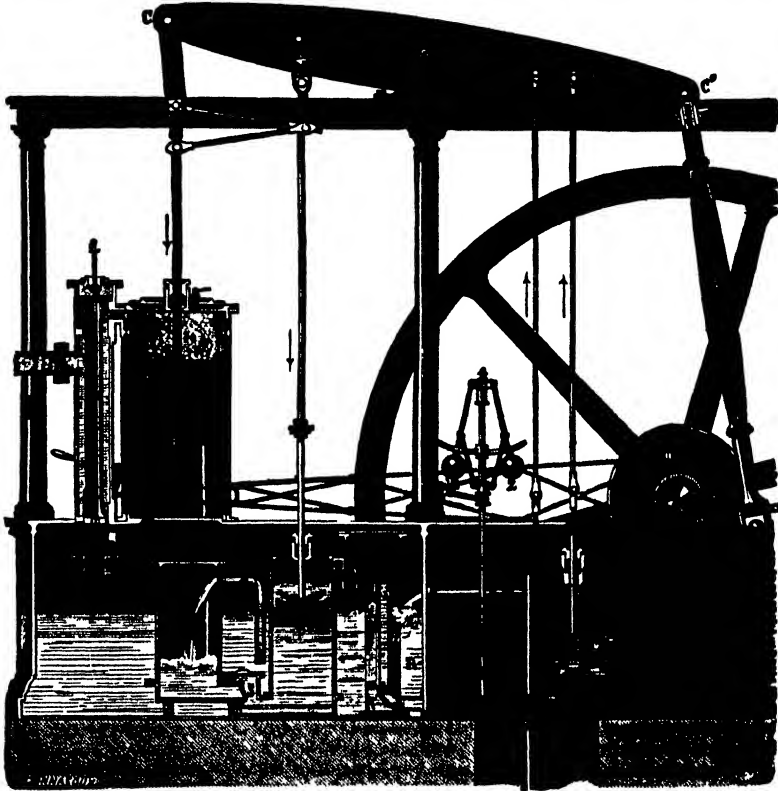


Fig. 4.—Watt's Engine

Watt was thus driven to the invention of that beautiful motion, the sun-and-planet wheel, as a substitute for the crank, for which he obtained a patent the same year. Mr. Jonathan Hornblower took out a patent in 1781 for an ingenious method of employing steam so as to act expansively. He employed two cylinders, first allowing the steam to act uniformly in one, and then to act by expansion in the other; but as he could not employ a separate condenser he could not bring his engine into use. This was compensated for by Watt, who in the year following, that is, in 1782, took out letters patent for his expansive engine. He employed only one cylinder, and effected the action from expansion, by admitting high-pressure steam at the beginning of the stroke, but cutting it off when the piston had moved a certain space, after which the steam expanded to the end of the stroke. It is but justice to add that Watt had employed the expansive engine both at Soho and Shadwell between the years 1776 and 1778. In 1784 he patented the parallel motion,

the object of which was to maintain the piston-rod in an upright position throughout the stroke. Previously the piston was attached to a chain, which lapped upon a wooden arch on the end of the beam; but this has been entirely superseded by the parallel motion.

The active mind of the ingenious inventor did not stop here. He had always regretted that one-half of the motion of the piston—in making the up-stroke—was unaccompanied by any work, as it was not difficult to see that a considerable addition of power could be derived from the engine if the pressure of the atmosphere were taken off the top of the piston when it was in the act of rising. This he effected by closing the top of the cylinder, so as to exclude the atmosphere, and opening a communication between it and the condenser. Having got so far he admitted steam on the top of the piston to press it down, as well as below to press it up; and thus he matured the *double-acting* engine, so called because steam was employed to produce both the up-stroke and the down-stroke.

An example of Watt's double-acting engine is illustrated in fig. 4. The piston is here shown making a down-stroke. The steam from the boiler passes direct to the valve-chest, which is simply a long box attached to the cylinder *F*. The valve-chest contains a valve *v* (technically called a *D*-valve), which consists of a hollow pipe, usually semi-circular in cross-section, and attached to a rod as shown. The valve *v* is operated by an eccentric *e*, on the main shaft, and in the given position is allowing the steam to enter the upper part of the cylinder, while the steam below the piston is passing into the condenser *H*, where it is being condensed by a jet of cold water. The condensed steam and injection-water, together with any air carried over by the water, is withdrawn from the condenser by means of an air-pump *P* and delivered into a cistern *R* called the hot-well. The feed-pump *W* draws water from *R* and forces it into the boiler. The piston-

rod and air-pump rod are made to move in parallel paths by means of the link-work *A B C D*, which is known as Watt's parallel motion. The speed of the engine is regulated by the governor *z*, which is driven from the main shaft by a belt and bevel gearing. The injection water is delivered into a tank *x* by a pump *U*.

In the hands of Watt the steam-engine assumed a shape and embodied principles which later engineers have not altered, but only added to and improved.

*The Ordinary Direct-acting Steam-Engine.*—The term *direct-acting* is applied to all engines in which the piston-rod is directly attached to the connecting-rod. Most engines in general use at the present

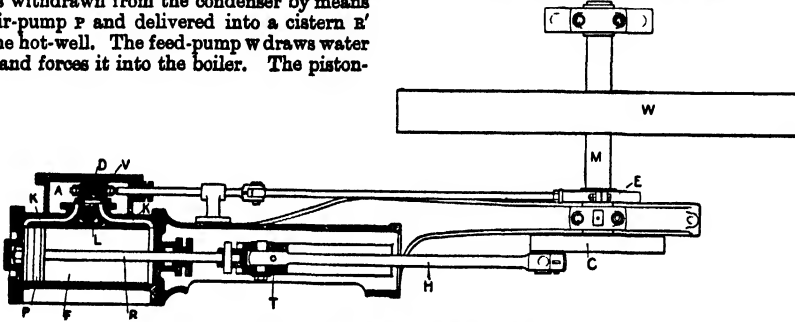


Fig. 5—Direct-acting Steam-Engine.

day are of this type. Fig. 5 shows a plan, partly in section, of a direct-acting engine. It must be assumed that there is a boiler which generates high-pressure steam as fast as it is needed, and that the steam is brought through a proper supply-pipe to the steam-chest *A* of the engine. The passage of the steam into and out of the cylinder *F* is regulated by a slide-valve *v*, which is given a reciprocating motion by an eccentric *e* keyed to the engine shaft *M*. Connection is made between the piston *P* and the crank *O* by means of a piston-rod *R*, cross-head *T*, and connecting-rod *H*. The steam enters and leaves the cylinder through the steam-ports *K*, and is discharged into the atmosphere or into a condenser through the exhaust-port *L*. Each stroke of the piston is produced by the pressure of the steam exerted on one face, while the exhaust takes place from the opposite side; both pressure and exhaust must change sides for a new stroke in order that successive strokes may be produced in opposite directions. Consequently at one end of the cylinder communication must be open to steam and closed to exhaust, and at the other end the communication must be open to exhaust and closed to steam. The slide-valve has a flat face which works in steam-tight sliding contact with the cylinder face; in the centre is a cavity *D* which permits either steam-port to communicate with the exhaust-port. It is usual for economical reasons to cut off the supply of steam to the cylinder before the end of each working stroke is reached, the remainder of the stroke being effected by the expansive energy of the steam. It is also necessary to retain some of the exhaust steam in the cylinder to act as an elastic resistance or cushion to arrest the movement of the piston, &c., at the end of each stroke, and thus prevent jar and shock to the various mechanical connections; both of the above results are obtained by putting *lap* on the valve.

*Lap*, outside *l*, or inside *l* (fig. 6), is the amount by which the valve overlaps the outer and inner edges respectively of the steam-port when the valve is in its mid-position. At the commencement of

each stroke the port is slightly open to steam (see fig. 6). This opening is called the *lead*.

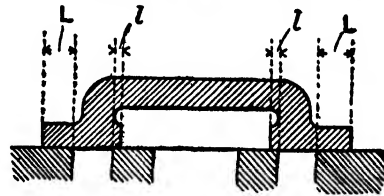


Fig. 6.—Slide-Valve.

*Eccentric.*—The slide-valve is commonly worked by an eccentric (fig. 7) rotating with the crank-shaft. The eccentric is a modified crank, and consists of a sheave or pulley *P*, provided with a strap *M* and rod *N*, to which the valve spindle is connected.

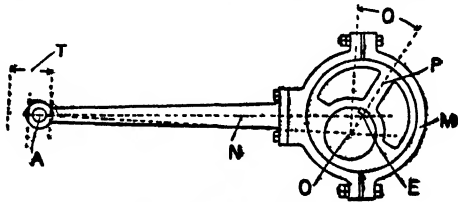


Fig. 7.—Eccentric and Rod.

*O* is the centre of the shaft and *E* the centre of the eccentric; *OE* is the *throw* or *radius* of the eccentric. The travel *T* of the valve is equal to twice the throw of the eccentric. The eccentric is set with its radius in a certain definite position with reference to the crank of the engine, thus:—the angle  $\theta$  is termed the *angular advance of the eccentric*, and is the number of degrees by which the angle between the eccentric radius *OE* and the crank centre line *OA* exceeds a right angle.

*Action of a Slide-Valve.*—There are four principal





operations to be noticed in the action of a slide-valve in distributing the steam in a cylinder.

OPERATIONS.		Fraction of Piston's Stroke.	Effect.
Name.	How Produced.		
"Cut-off."	By closing port on driving side to steam.	About $\frac{7}{8}$ with single valve	To take advantage of expansive property of steam.
"Release."	By opening port on driving side to exhaust.	0 to $\frac{25}{32}$ .	To greatly reduce the driving pressure, and to provide sufficient opening to exhaust on commencement of return stroke.
"Compression."	By closing port on exhaust side to exhaust.	$\frac{25}{32}$ to 0.	To absorb momentum of piston, &c., by the resistance of steam cushion.
"Admission."	By opening port on exhaust side to steam.	Just before end of stroke.	To complete action of compression, and bring full pressure on piston at commencement of return stroke.

The relative positions of slide-valve, piston, crank, and eccentric are easily understood by referring to fig. 8, in which *v* is slide-valve, *p* piston, *o* *a* crank, and *o* *e* eccentric. The arrows indicate the direction in which each part is travelling. Owing to the obliquity of the connecting-rod to the line of stroke the piston is more advanced in the out-stroke and less advanced in the in-stroke than it should be to correspond exactly with the crank's position, so that the cut-off, release, &c., do not occur at the same points on the out and in strokes.

With a single slide-valve, as shown in all the preceding figures, it is not usual to cut off the steam earlier than about half-stroke, because the arc travelled through by the crank during expansion is exactly equal to the arc during which compression occurs; for good working the latter should be independent of the former. When an earlier cut-off is desired it is necessary to use some other method of distributing the steam, or to supplement the ordinary slide-valve with another valve which is worked independently by a separate eccentric; this second valve is called an *expansion valve*. The most common type of expansion valve is that known as Meyer's (fig. 9). It consists of two plates *e* *e*, sliding at the back of the main valve *m*. The main valve controls the *admission*, *release*, and *compression* of the steam. The point at which cut-off takes place is determined by the distance apart of the plates *e* *e*; the farther apart, the earlier the cut-off. The above plates are provided with suitable nuts working on right- and left-handed screws cut on the valve-spindle *a*. Means are generally provided by which the distance apart of the plates can be adjusted while the engine is running, and thus the power developed by the engine may be made to correspond to the work done.

The travel of a slide-valve is equal to the distance moved through by the valve in one stroke of the piston.

Travel = Twice (outside lap + greatest opening of port to steam).

**Double-ported Slide-Valve.**—This type of valve (fig. 10) is used for large cylinders in order to lessen

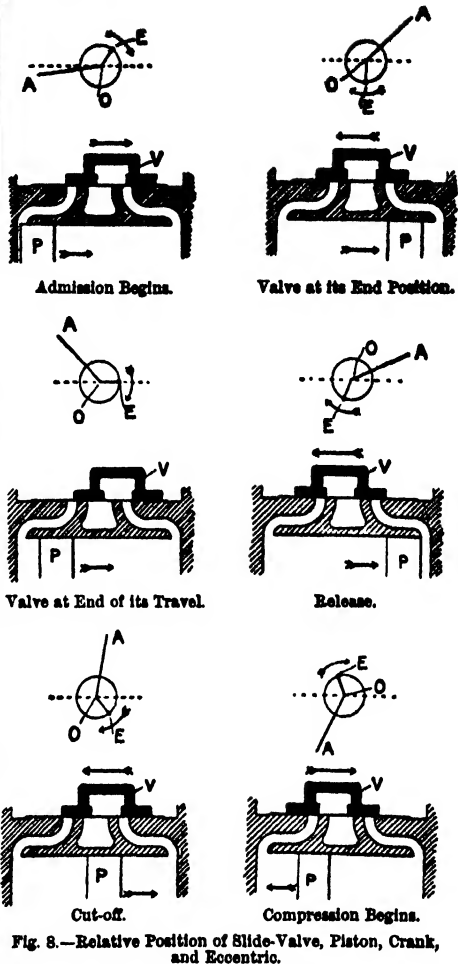


Fig. 8.—Relative Position of Slide-Valve, Piston, Crank, and Eccentric.

the necessary travel without reducing the area of steam-port opening. There are two openings *h* *h*

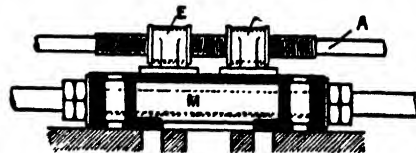


Fig. 9.—Meyer's Variable Expansion Gear.

to each steam-port, instead of one only, as in the case of the ordinary slide-valve. The steam is ad-

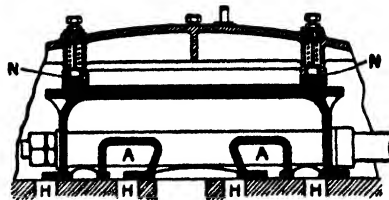


Fig. 10.—Double-ported Slide-Valve with Relief Ring.

mitted to the outside openings in the usual way,

over the outer edges of the valve, but the two inner openings get their steam from the passages *AA*, cast in the body of the valve. The advantage of this arrangement is that for a given movement of the valve twice the area of steam-port is uncovered as with an ordinary single-ported valve, consequently for a given area of port-opening the travel may be greatly reduced.

**Piston-Valve.**—When high steam-pressures are used, the force pressing the slide-valve against the surface upon which it slides may be very great, and consequently the power absorbed in overcoming friction is considerable. To overcome this defect many methods have been devised, such as piston-valves, and relief-rings at the back of the slide-valve, &c. The piston-valve (fig. 11) consists of two pistons *AA*, connected together, one to each port, the width of each piston being the same as the width of face in an ordinary slide-valve. The valve works up and down in two cylindrical spaces in which are cast the openings to the steam-ports *SS*; *E* is the exhaust-port and *F* the steam supply-pipe. The piston-valve may be described as a slide-valve in which the valve face is curved to form a complete cylinder. The piston-valve is generally made hollow, as shown, to

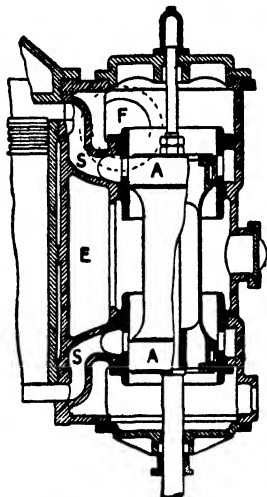


Fig. 11.—Piston-Valve

allow the steam to pass from one end of the steam-chest to the other. The pistons are provided with ordinary spring-ring packings to keep them steam-tight. As far as the steam-pressure is concerned this type of valve is entirely balanced, since the area exposed to pressure is the same top and bottom, and the only friction is that arising from the necessary tightness of the packing-rings.

**Relief-Ring.**—This is a ring *N* (fig. 10), fitted between the steam-chest cover and the back of the slide-valve, and serving to exclude the steam from the greater part of the back of the latter. The ring fits steam-tight into a recess in the steam-chest cover, and works steam-tight against the back of the valve. The force required to move the valve is thus considerably reduced.

**Corliss Valve Gear.**—In large modern stationary engines the most usual plan is to regulate the admission of steam by some form of *tappet-motion* and *trip-gear*, which enables the steam to be cut off very sharply. Of the various kinds of trip-gear the Corliss and its modifications is the most common. In the Corliss system there are four ports in the cylinder and four valves. The two upper ports are intended solely for the admission of the steam, and the two lower ones for the exhaust. The valves are formed of portions of cylinders which oscillate on a cylindrical face. A transverse section of a Corliss valve is shown in fig. 12. The valve *V* can oscillate about *A* as centre; *E* is the steam-port. The exhaust-valves are opened and closed by links connected with an oscillating piece, termed a 'wrist-plate', which takes its motion from an eccentric on the

crank-shaft. The steam valves are opened by a similar wrist-plate operated by another eccentric, but they are closed by springing back when released by a trip or trigger action. The moment at which

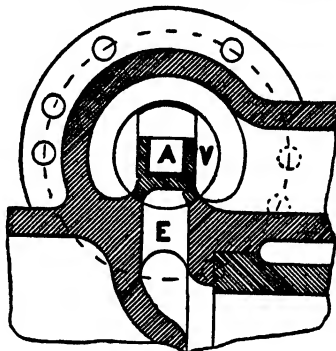


Fig. 12.—Corliss Valve.

the trip occurs is determined by the governor, whose function in this type of gear is not to close the valve, but to determine when it shall be closed; hence the rate of expansion is controlled automatically. The steam-valves are opened with equal rapidity whether the cut-off is going to be early or late. They remain open during the admission, and when the trip-action comes into play they close suddenly. The steam-valves are connected by suitable link-work to dash-pots, whose function is to return the valves quickly and noiselessly when the governor releases the trip-catch. As the piston in the dash-pot is moved outwards by the valve gear during the steam admission, a vacuum is formed behind the piston, which is pressed back by atmospheric pressure. The speed of closing can be accelerated or retarded by regulating the amount of opening of an air-valve attached to each dash-pot.

A trip-gear is not suitable for high-speed engines, about 120 revolutions per minute being probably the limit of speed, but without the trip-gear the Corliss system may be used for higher rotational speeds.

Owing to the fact that separate ports are used for steam and exhaust, there is much less loss of steam, due to condensation in the steam passages of the cylinder, in this type of gear than with the ordinary slide-valve gear. In fig. 4, Plate I, a type of Corliss gear is shown as applied to an engine of large power, made by Messrs. Hicks, Hargreaves, & Co., Bolton.

**The Governor.**—The governor was invented by Watt for the purpose of regulating the admission of steam into the cylinder in such a manner as to govern or regulate the speed of the engine, causing it to move at a rate which is uniform or nearly uniform, whilst the resistance to be overcome may vary. If, during the working of an engine, the load were wholly or partially removed, or increased, while the supply of steam to the cylinder remained undiminished, the engine would quickly attain a speed considerably in excess, or much less than the normal rate at which the engine was intended to run. It is, however, of the first importance that uniformity of speed under all variations of load or work should be maintained.

The centrifugal governor of Watt (fig. 13) consists of two heavy metal balls *AA*, attached to two arms, which are hinged to a pin *P*, common to both, in the axis of a vertical spindle. Two other rods *EE*, *E'E'* are jointed to the first ones so as to form with them a linkage, the lower ends of the second rods being





joined to a sleeve  $HK'$ , capable of sliding on the central spindle. The latter is connected by gearing with the main shaft of the engine so as to revolve at a rate strictly proportional to that of the shaft. If

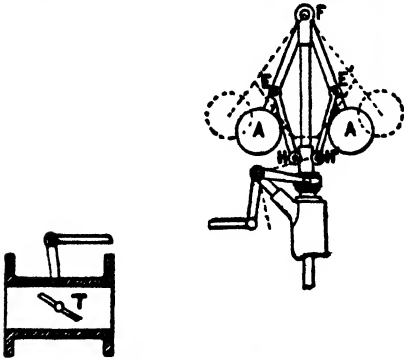


Fig. 13.—Watt Governor.

the power of the steam be in excess the speed of the engine is accelerated, the balls, in virtue of the centrifugal force imparted to them, fly outwards from the axis of rotation, their distance from the axis increasing with the velocity. The balls in receding from the spindle rise, and thus cause the sliding-sleeve to be proportionally moved on the spindle. The sliding-sleeve is connected by a system of levers with a throttle-valve  $T$  in the main steam supply-pipe; the throttle-valve is turned on its axis so as to diminish the opening in the steam-pipe when the speed increases. On the other hand, if the power of the steam be in defect, the balls collapse and the throttle-valve opens more widely. The original form of Watt governor is only suitable for running at slow speeds; for quick-running engines a Watt governor, if geared down so as to run slower than the engine, would not be sufficiently sensitive. At the present day the tendency is to build high-speed engines, and the Watt governor is now largely superseded by various forms of high-speed governors, of which the 'Pickering' (fig. 14) is a type. Three balls are employed, each fixed in the middle of a separate flat spring. The lower ends of these springs are attached to a collar formed on the driving-pinion, which runs free on a fixed central tubular column, but is prevented by a collar from rising. The upper ends of the springs are secured to a cap at the top of the column, the cap being free to revolve and also to rise and fall, so that as the balls diverge under the centrifugal force the top cap is drawn down, and with it a central spindle, the lower end of which is connected to an equilibrium throttle-valve contained in the steam passage below. The normal speed of the governor may be altered by means of an adjustable arm or lever fixed on the end of a horizontal shaft, and forked to take into a grooved collar on the central spindle. The shaft is turned by means of a worm and worm-wheel at the

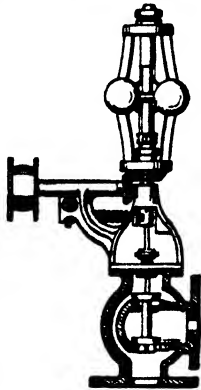


Fig. 14.—The Pickering Governor.

other end of the shaft, through the medium of a helical spring connecting the worm-wheel with the lever. In proportion as the spring is tightened by the turning of the worm-wheel, it causes an upward pressure of the forked lever on the central spindle, counteracting to that extent the effect of the weight of the balls, and so varying the speed of the governor as required. The governor is driven by a belt from the main shaft of the engine.

The above governors throttle or wire-draw the steam and thereby reduce its pressure, thus lessening the amount of work it can do. In many modern engines the governor is arranged to act directly on the expansion gear of the slide-valve in such a manner that as the speed increases above the normal rate the steam is entirely cut off at an earlier period of the stroke, and thus the power of the engine is proportionally reduced. An example of this type of governor is shown in fig. 15, which represents a Hartnell governor arranged to vary the cut-off. The balls are on inverted arms forming parts of

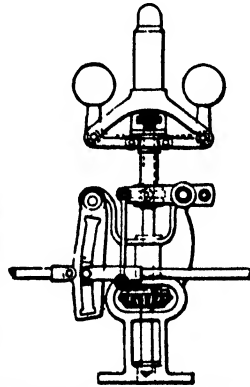


Fig. 15.—The Hartnell Governor.

bell-crank levers, the horizontal arms of which bear, by means of rollers, on the sleeve or slide through which the motion is given off. A helical spring, enclosed in the upper part of the governor and surrounding the spindle, is acted upon by the sleeve as it rises or falls, and is compressed or released accordingly. The cut-off is varied by means of link-gear, in which the link, moved by an eccentric, vibrates on a pin through its upper end, and the sliding-block in the link is raised or lowered by the action of the governor on the radius-rod connected to the valve spindle, thus varying the travel of the expansion-valve and the cut-off. The expansion-valve works at the back of a main valve, the arrangement being similar to the Meyer's gear (fig. 9), except that there is only one plate instead of two as in the latter gear.

High-speed governors are much more sensitive to alterations of speed than the slow-speed types, also the parts can be made much lighter and move with less friction.

In some types of high-speed engines it is customary to use what is known as a *shaft-governor*. In this form of governor the balls, or weights, are arranged about the main shaft of the engine, sometimes within the fly-wheel, the control being given by springs. The governor acts directly upon the eccentric, and the regulation of the speed of the engine is effected by varying the position of the eccentric centre relatively to the centre of the shaft, and thus varying the travel of the slide-valve.

**The Fly-Wheel.**—In addition to the variations in speed brought about by changes of load on the engine, and which the governor tends to correct, there is a constant tendency to fluctuation in speed during each revolution, over which the governor has no control. This fluctuation of speed is due to the varying rate at which work is done on the crank-shaft during each revolution. The object of the fly-wheel is to equalize the action of the force transmitted from the piston to the crank-pin, and to

confine any inequality within narrow limits of variation. The fly-wheel consists of a heavy wheel of cast iron with massive rim, which, owing to its great mass, and to the distance of the mass from the centre of the shaft, tends to resist any change of speed. The fly-wheel acts by forming a reservoir of energy to be drawn upon during those parts of the revolution in which the work done on the shaft is less than the work done by the shaft, and to take up the surplus in those parts of the revolution in which the work done on the shaft is greater than the work done by it. In an engine with two or more cranks suitably disposed with reference to one another, the total turning effort on the shaft is more equally distributed than in a single-crank engine, the speed is consequently much more uniform; this is one reason why triple-cylinder engines are now so largely used.

At each end of the stroke, the centre line of the connecting-rod and of the crank coincides with the axis of the cylinder; the crank is then said to be on its *dead-centre*. In this position there is no tendency of the crank to rotate, and with a single-crank engine it is necessary to 'bar' the engine round till the crank is off the dead-centre before it can start. When there are two engines working the same shaft, their cranks being at right angles, as in a locomotive, there is, as a rule, no difficulty in starting, because when one crank is at a dead point the other cannot be. When the engine is in motion, the fly-wheel helps the crank over the dead-centres.

**Condensation of Steam.**—There are two general divisions of steam-engines: *condensing engines* and *non-condensing engines*. The engines of the latter division, in exhausting steam, have necessarily to oppose the pressure of the atmosphere, amounting to an average of 14·7 lbs. per square inch, whilst the former have only the opposition of the small pressure remaining in the condenser, say 2 lbs. per square inch. In practice, owing to frictional resistances in the steam-pipes and passages, the actual pressures acting against the engine piston may amount to 17 and 3 lbs. per square inch respectively. It therefore follows that condensing engines are more efficient in the production of power from fuel than non-condensing engines. Condensing engines have a further advantage, since with them it is possible to expand the steam, which acts on the piston, to a lower pressure before leaving the cylinder than can be profitably done when the steam exhausts into the air. Non-condensing engines, on the contrary, have the advantage of greater simplicity, with comparative fewness of parts, and there are many circumstances under which it would be impracticable to employ steam-power at all, if the condensation of steam could not be dispensed with.

**Condensers.**—The condenser is a cold chamber into which the exhaust steam is discharged after it has done its work in the engine cylinder. The exhaust steam on entering this chamber is immediately condensed, giving up its heat to the condensing water, and at the same time the air contained in the water and exhaust steam is disengaged. It is necessary to pump out both the heated water and the disengaged air, which would, if allowed to remain, accumulate in and fill the condenser. The pump which effects this, known as the *air-pump*, is usually driven from the engine.

Condensers are of various types, which may be divided as follows:—

**Jet Condensers.**—For land engines this form of condenser is most generally used. The earliest forms of condensers and air-pumps were vertical and single-acting, and were generally applied to beam-engines (see fig. 4). When horizontal engines

came into fashion the air-pumps were often vertical, worked by means of a bell-crank lever; but owing to the number of parts required to drive a vertical air-pump in this way, the simpler method of putting

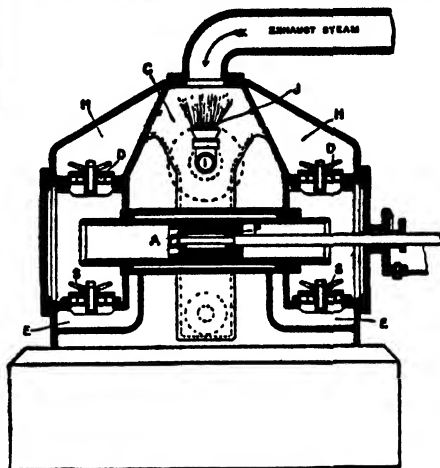


Fig. 16.—Horizontal Jet Condenser.

the air-pump horizontal and surrounded by the condenser has come into use to a large extent. In this arrangement the air-pump is in the same line as the piston-rod, and is driven directly from it.

A horizontal jet condenser is shown in fig. 16. The exhaust steam, on entering the condensing chamber 'C', is met with jets of cold water spraying from a rose-head 'J' at the end of the injection pipe 'I'. The steam is condensed, and together with the condensing water is collected in the lower part 'X' of the condenser chamber, from which it is pumped into the upper compartment 'H', and finally discharged. 'A' is the air-pump, 'P' the air-pump piston, 'S' suction- and 'D' delivery-valves.

**Surface Condensers.**—In this form (fig. 17) steam is condensed by contact with a cold metallic surface, formed by a large number of thin brass tubes 'T',

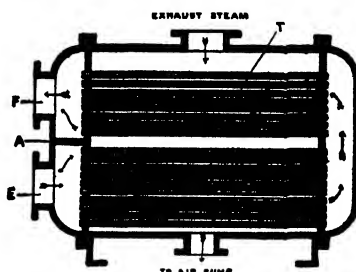


Fig. 17.—Surface Condenser.

through which a current of cold water is circulated by means of a circulating pump. The circulating water enters at 'E' and is compelled by a plate 'A' to pass first through the lower set of tubes and to return through the upper tubes to the outlet pipe 'F' leading to the overflow. The condensed steam falls to the bottom of the condenser, which is in communication with the air-pump. The surface condenser is now entirely used in connection with marine engines; it is also adopted for stationary engines in cases where it is desired to return the condensed steam to the boilers, and when the condensing water is too impure to be used as feed.

**Evaporative Condensers.**—This form of condenser is very convenient in cases where the supply of condensing water and storage capacity are limited. It usually consists of a large number of tubes for the exhaust steam, the outside surfaces of the tubes being exposed to currents of air, either natural or artificial; in the latter case the tubes are placed inside a closed casing or chimney, through which a strong draught is produced by means of a fan. Small streams of water are allowed to trickle over the external surface of the tubes, and by its evaporation extracts heat from the exhaust steam; an air-pump is connected with the system of pipes to maintain a vacuum therein.

**Ejector Condensers.**—In Ledward's ejector condenser (fig. 18) the condensing water passes through

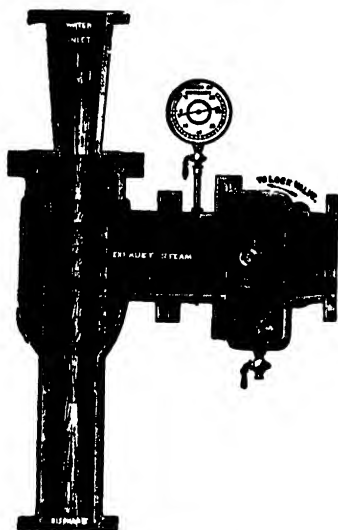


Fig. 18.—Ejector Condenser.

the apparatus in the form of a round, solid jet, and becomes mixed with the exhaust steam as it traverses a series of specially-shaped nozzles, until it issues as warm water from the discharge pipe. This type of condenser is very efficient, but should be used only in places where there is an ample supply of cold water. No air-pump is required, there are no moving parts, and it is very simple in its connection to an engine. The water should flow into the condenser under a head of 15 to 20 feet; if a natural head is not available, a pump will be required. There are several other types of ejector condensers, but the principle of action is practically the same as in the above.

**Expansive Working of Steam.**—When the pressure of the steam admitted to the cylinder is sufficiently high, the steam is not allowed to flow into the cylinder for the whole of the stroke, but the supply is cut off at some distance from the end of the stroke. The consequence is, that for the remainder of the stroke the steam already shut into the cylinder acts on the piston simply by its own elastic or expansive force. There is a certain degree of economy in this practice, for if, for example, the steam be cut off when only half the stroke is performed, then the steam will only be expended at half the rate of consumption that would be followed if it were admitted freely into the cylinder for the whole of the stroke; whilst, on the contrary, the work done by the steam on the piston for one stroke would be more than half the work it would do if admitted

for the whole of the stroke, by as much as the work it does by its independent expansive force. The total work done would be six-sevenths of the work done if the steam were admitted for the whole of the stroke, and the gain of work obtained from a given quantity of steam would be over 60 per cent, assuming there is no loss due to condensation of steam in the cylinder. The following table gives the comparative performance of 1 lb. of steam worked expansively when cut off at different points of the stroke, no allowance being made for condensation losses, &c.:—

Fraction of Stroke at which Steam is cut off.	Comparative Performance of 1 lb. of Steam.
1	1.00
$\frac{2}{3}$	1.26
$\frac{1}{2}$	1.62
$\frac{2}{5}$	1.96
$\frac{1}{3}$	2.19
$\frac{2}{4}$	2.86
$\frac{1}{4}$	2.87
$\frac{1}{5}$	3.00

From this table it appears that the efficiency or the performance of a given weight of steam may be more than doubled by the expansive system of working it, and that the more expansively the steam is worked, the higher is the efficiency of the steam. This proportion would hold good if the steam were perfectly protected from radiation of its heat, or from condensation, whilst it is within the cylinder; but these conditions have not yet been attained in practice. On the contrary, when it is attempted to work steam very expansively in the cylinder, it is subject, by the very nature of the operation, to an excessive condensation, the loss by which neutralizes the gain by expansion. When steam expands in a cylinder from a higher to a lower pressure, the temperature of the steam falls at the same time; and when the temperature of the steam falls, it cools down the walls of the cylinder with which it is in contact, abstracting heat from them. The consequence is, that when the next charge of steam at the higher pressure is admitted into the cylinder, it strikes against the comparatively cold surfaces of the cylinder, which absorb heat from it until they are raised again to its own temperature, and the heat so abstracted can only be obtained by the condensation of a portion of the steam in contact with the metals, and the consequent liberation of the heat. And since the more expansively the steam is worked the greater is the variation of pressure, and therefore of temperature, the greater must be the proportion of steam that is condensed in the manner just described. So potent is the condensing agency of the cylinder that in ordinary engines it has not been found economical to cut off the steam at a shorter period than one-third of the stroke.

But though the destructive condensing action of the cylinder cannot be wholly prevented, it may be mitigated to a considerable extent by expedients for projecting heat through the walls into the cylinder, and for maintaining the metal at a higher average temperature than when left unaided. For this purpose the cylinder is surrounded by steam taken direct from the boiler and lodged in a jacket as it is called, in which the cylinder is inclosed. Since the steam in the jacket is in constant communication with the boiler, its pressure and temperature are necessarily maintained at their maximum, and heat is being constantly transmitted through the walls of the cylinder, and radiated into the inclosed steam. By such means, it is believed, the expansive working of steam may with advantage be extended to a ratio of

six times the initial volume, that is, that the steam may be cut off at about a sixth of the stroke of the cylinder.

**The Compound Engine.**—In order to secure economy in the steam-engine it is necessary to use high initial pressures, and by working the steam expansively recover as much as possible of its internal energy. The internal surfaces of steam cylinders are exposed to varying temperatures, ranging from that of the entering steam to that of the exhaust. This variation in temperature naturally becomes greater with increased expansion, and causes a large quantity of the incoming steam to be condensed without doing any work. The chief object of the compound system is to reduce this waste by allowing the steam to expand successively in two, three, or more cylinders of increasing diameters, in each of which one stage of the total expansion is carried out, each stage representing only a moderate expansion; the variation in temperature in each cylinder is thus not excessive, consequently the loss of steam due to cylinder condensation is considerably reduced. The system of compound expansion is now used in nearly all large engines that pretend to economy, and its introduction forms the only great improvement which the steam-engine has undergone since the time of Watt.

The number of cylinders used depends upon the initial pressure and the range of expansion, thus:—*Double* or *two-stage* expansion engines, commonly known as compound engines, with pressures from 60 lbs. to 100 lbs. *Triple* or *three-stage* expansion engines, with pressures ranging from 120 lbs. to 170 lbs. or more. *Quadruple* or *four-stage* expansion engines, with higher pressures than the above.

Referring to fig. 19, which represents a section through the cylinders and valve-chests of a com-

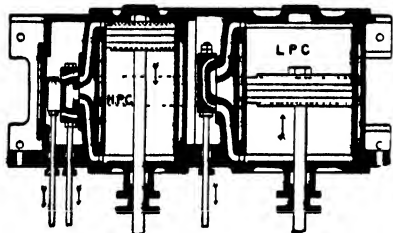


Fig. 19.—Section through the Cylinders of a Compound Engine.

pound engine, the steam from the boiler is first admitted in the ordinary way into a cylinder, H.P.C., termed the *high-pressure cylinder*, in which it undergoes a moderate expansion. The steam is then exhausted into a larger cylinder, L.P.C., called the *low-pressure cylinder*, where the expansion is completed. Each cylinder is usually fitted to work a separate crank. In the above engine the cranks are set at right angles to one another, therefore the pistons in the two cylinders are always half a stroke apart, consequently the low-pressure cylinder is not always in a position to take the steam direct from the high-pressure cylinder. To meet this, the steam from the high-pressure cylinder is discharged into a vessel called a *receiver*, and at the proper moment is admitted to the low-pressure cylinder. In practice, except in certain cases, it is not usual to have a special chamber for a receiver, as the exhaust-pipe of the high-pressure cylinder and the steam-chest of the low-pressure cylinder generally afford sufficient capacity for the purpose. In very large engines there may be two high-pressure and two low-pressure cylinders. In a triple-expansion engine,

the exhaust steam from the high-pressure cylinder passes into an *intermediate cylinder* and expands therein before exhausting into the low-pressure cylinder.

The compound system conduces not only to economy, but also to smoothness of working. Two or more cranks are used, and the variation of pressure on each crank is less than in the case of a simple engine of equal power.

The consumption of fuel per hour for each indicated horse-power in a well-designed triple-expansion engine will be about  $1\frac{1}{2}$  lb., while in the best type of single-expansion engine it is rarely less than  $3\frac{1}{2}$  lbs.

In the *tandem compound engine* the high-pressure cylinder is in line with the low-pressure cylinder, and the two pistons are attached to the same piston-rod.

Examples of some of the more commonly occurring types of compound engines are described and illustrated at the end of this article.

**Horse-Power of Steam-Engines.**—Whenever a force is exerted through a distance *mechanical work* is said to be done. The unit of work, the *foot-pound*, is the work done in overcoming a resistance of *one pound* through a distance of *one foot*. The rate at which work is done is measured by the number of foot-pounds done in an hour, or a minute, or a second; rate of doing work is termed *power*.

The unit of power which is universally adopted to represent the rate of work of a steam-engine is called a *horse-power*, and is represented by 33,000 foot-pounds of work done in one minute.

This unit was proposed and used by Watt.

The actual power exerted by the steam within the cylinder of an engine is termed the *indicated horse-power* (I.H.P.).

The *actual* or *brake horse-power* (B.H.P.) is the power actually given out by the engine at the crank-shaft, and is represented by the indicated horse-power minus a portion expended in overcoming the

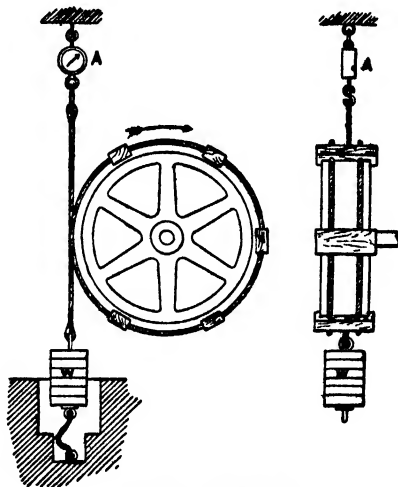


Fig. 20.—Rope-Brake.

friction of the engine. The brake horse-power is usually ascertained by means of a friction-brake applied to the fly-wheel of the engine.

The ratio of the brake horse-power to the indicated horse-power is termed the *mechanical efficiency* of an engine.

A very simple and efficient form of friction-brake is shown in fig. 20. It consists of a rope passed





round the fly-wheel, and prevented from slipping off the wheel laterally by a few wood blocks, which are made to clamp the rim in the manner sketched; the blocks are grooved to receive the rope or ropes, which should stand well out from the surface of the blocks. The slack end of the rope is attached to a spring-balance *A*, and the other end is loaded with weights *W*.

Let *W* = total load on rope.

Let *S* = pull indicated by spring-balance.

Let *C* = effective circumference of brake-wheel, measured to centre of rope, in feet.

Let *N* = number of revolutions per minute.

Then the brake horse-power:—

$$\text{B.H.P.} = \frac{(W - S)CN}{33,000}.$$

**The Indicator.**—The indicated horse-power above-mentioned is so called because the work done by the steam in the cylinder is estimated from an *indicator diagram*. The indicator, originally invented by Watt and improved by M'Naught, Richards, and others, is an instrument by which diagrams showing the relation of the steam-pressure in the cylinder of an engine to the movement of the piston are automatically recorded. One of the best forms in general use at the present day is the Crosby Indicator (fig. 21), which consists essentially of a small cylinder *C*, provided with a piston *P* and cover *B*. Between the cover and the piston a double helical spring *S* of a known strength is placed. The cylinder of the indicator is connected by means of a cock and short pipe to one or other

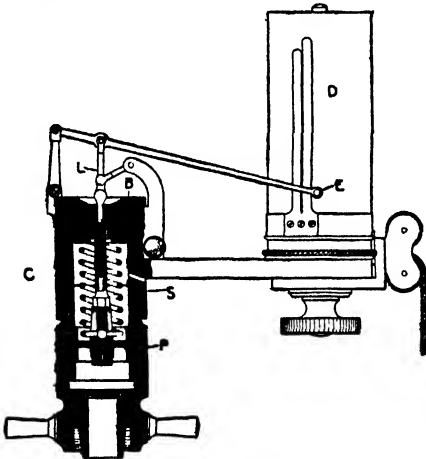


Fig. 21.—Crosby Indicator.

end of the interior of the engine cylinder, and the steam acting on the under side of the piston *P* causes it to rise and fall in response to the fluctuations of pressure occurring in the engine cylinder. The space above the indicator piston is in constant communication with the atmosphere, so that the piston will descend in proportion to the degree of vacuum in the cylinder. The indicator is fitted with a system of link-work *L*, constituting a parallel motion by means of which the movement of the piston *P* is reproduced on a magnified scale by a pencil placed at *E*. A strip of paper is attached to a drum *D*, which is made to rotate backwards and forwards on its own axis in unison with the engine piston; the drum is pulled round in one direction by a cord

connected to a motion-reducing mechanism worked from the engine crosshead, and is returned in the opposite direction by the action of a coiled spring within the drum. By the combined movement of the pencil *E* (caused by the steam pressure) and the paper a closed figure is drawn, called an *indicator diagram*, the area of which represents to scale the effective work done on the engine piston.

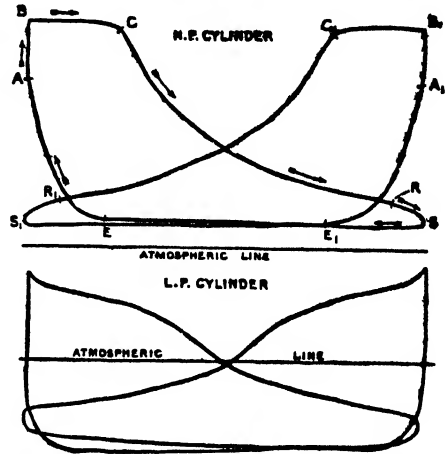


Fig. 22.—Indicator Diagrams from Compound Condensing Corliss Engine.

The indicator diagrams shown in fig. 22 were taken from the opposite ends of the cylinders of a compound Corliss engine, indicating 386 horse-power.

Before admitting steam to the indicator, the pencil is pressed against the paper on the drum, marking the *atmospheric line*—the piston of the indicator then being only subjected to the pressure of the atmosphere. It should be noticed that the high-pressure cylinder diagrams are wholly above the atmospheric line, while in the case of the diagrams taken from the low-pressure cylinder, which during the exhaust is in communication with the condenser, part of the diagram is above, and part below, the atmospheric line; the depth of the diagram below the atmospheric line indicates the degree of vacuum in the cylinder. Since the pressure of the steam in the high-pressure cylinder is much higher than the pressure in the low-pressure cylinder, springs of different strengths are used in the indicator for each cylinder, consequently the above diagrams are drawn to different scales.

Besides being used for obtaining the power of an engine, the indicator diagram gives much valuable information as to the working of the engine, especially with regard to the action of the valve or valves in distributing the steam. Steam begins to enter the cylinder at *A* (*admission*), when the piston is nearly at the end of the return stroke and just about to commence a new stroke. The pressure of steam attains its highest point at *B*, the engine piston then moves along the cylinder, the pencil describing the nearly horizontal line to *C* (called the *steam* or *admission* line), at which point—the point of *cut-off*—the supply of steam from the boiler is shut off. The expansion of the steam that is shut in the cylinder now commences, the pressure falling as indicated by the curved line (*expansion curve*) from *C* to *E*. At *E*, the point of *release*, before the piston arrives at the end of the stroke,

the exhaust valve begins to open and allows the steam to escape into the receiver. From *s* to *m* the exhaust-port remains open, and the piston on its return stroke pushes out most of the steam in the cylinder. At *m* the exhaust-valve closes (compression), and the steam remaining in the cylinder is compressed until the piston reaches the end of its stroke again, when the cycle of operations is repeated. The line *s o s* indicates the varying pressures during the forward stroke, and the line *s e s* (the back-pressure line) represents the back pressures, or pressures which are acting against the forward pressures. The true back-pressure line for the left-hand diagram is the line *s<sub>1</sub> e<sub>1</sub> s<sub>1</sub>* on the right-hand diagram, since it refers to the opposite side of the piston. The cycle of operations for the low-pressure cylinder is exactly the same as described above, and can be easily followed.

As regards the method of calculating the indicated horse-power, if *P* represent the mean effective pressure on the piston in pounds per square inch, *A* the area of the piston in square inches, *L* the length of the stroke in feet, and *N* the number of strokes per minute (which is equal to twice the number of revolutions per minute), then the work done on the piston per minute in foot-pounds is *P L A N*, and the indicated horse-power (I.H.P.) is given by the equation:—
$$\text{I.H.P.} = \frac{P L A N}{33,000}$$

**Classification of Steam-Engines.**—A classification may be adopted, based on the uses to which engines are applied. (1) *Stationary Engines*, comprising all sorts of engines which are fixed permanently, and used for driving factory and other machinery, dynamos, pumps, &c. (2) *Portable and Traction Engines*. Portable engines are fixed on wheels, and carry the boiler with them; they can be moved from place to place for temporary service as stationary engines. Sometimes portable engines are arranged for self-movement, and traction engines are used for drawing loads on common roads. (3) *Locomotive Engines*, for drawing loaded carriages and wagons on railways (see LOCOMOTIVE ENGINE and RAILWAYS). (4) *Marine Engines*, for propelling vessels on water (see also STEAM NAVIGATION).

In stationary engines alone there is great variety, both condensing and non-condensing. For mill-driving, and the general purposes of a rotative engine, the beam type is now rarely chosen. In pumping engines it is more common, but even there the tendency is to use direct-acting forms. In modern practice the direct-acting type of engine is almost universally adopted. There are *horizontal*, *vertical*, and *inclined cylinder* engines, the position of the cylinder determining the type of engine.

**Stationary Engines.**—A horizontal non-condensing 'girder' type engine, by Messrs. Tangye, is shown in fig. 1, Pl. I. The diameter of cylinder is 12 inches, and stroke 24 inches. It is fitted with the Tangye-Johnson patent automatic expansion gear, the point of cut-off being determined by the governor, which is of the 'Porter' type. A feed-pump, worked from the valve spindle, is shown at the rear of the cylinder. An engine of this size has given under test 52 I.H.P. when working non-condensing with 100 lbs. steam pressure per square inch, with a steam consumption of 26 lbs. of steam per indicated horse-power per hour.

A vertical engine, also by Messrs. Tangye, is illustrated in fig. 2, Pl. I. Diameter of cylinder 6 inches, and stroke 6 inches; the fly-wheel is fitted with a crank-shaft governor, which automatically controls the admission of steam to the cylinder by altering the position of the eccentric. The standard is self-contained (requiring no outer bearing), and

combines in one casting the lower cylinder cover, the crosshead guide, and the main bearings. The valve is of the balanced piston type. With a pressure of steam of 100 lbs. per square inch above the atmosphere this engine will develop 12 brake horse-power at 350 revolutions per minute.

A very high class single-cylinder engine, made by Messrs. Hicks, Hargreaves, & Co., Bolton, is illustrated in fig. 4, Pl. I. The valve gear is of the 'Corliss' type, and is patented by the firm. The fly-wheel, not shown in the illustration, is usually grooved for rope-driving. This particular class of engine is made in sizes from 50 to 500 I.H.P.

One of two sets of vertical triple-expansion, direct-acting, surface-condensing engines, made by Messrs. Fleming & Ferguson, Paisley, for the Crossness pumping station, near London, is shown in Pl. I., fig. 5. The cylinders are 22 inches, 35 inches, and 58 inches diameter, with 48 inches stroke; the pump-plungers being 68 inches diameter. The head of water against which the pumps are working is 30 feet. When making 20 revolutions per minute the pump H.P. is 343, with an I.H.P. of 440. The engines are said to be capable of pumping 4,215,000 gallons per hour.

Engines for supplying motive power for electric traction purposes are now being built on lines similar to fig. 6, Pl. I., which represents one of two sets of engines built by Messrs. J. Musgrave & Sons, Bolton, for the Glasgow Corporation in connection with the electric tramways. The engines are of the vertical inverted, direct-acting, three-cylinder, two-stage compound, condensing type, with massive cast-iron A standards and Corliss valves. They are to exert 5000 horse-power as a maximum, or 4000 horse-power at normal load. The cylinders are: high-pressure, 42 inches in diameter, two low-pressure, each 60 inches in diameter; all of 5 feet stroke. The steam pressure is 150 lbs., and the speed 75 revolutions per minute. There are three cranks set at 120° apart. The diameter of the crank-shaft varies from 22 inches at the high-pressure-cylinder end to 36 inches at the part upon which the fly-wheel is keyed. The fly-wheel is 24 feet in diameter, and weighs 145 tons, of which 90 tons are in the rim. The total height of the engines is 35 feet, and the total weight over 750 tons.

It has already been pointed out that increased expansion in an engine cylinder is attended with some considerable loss, due to condensation brought about by the corresponding variation in temperature. A very satisfactory method of reducing this cylinder condensation is to use *superheated steam*, which is steam heated to a very high temperature after it has left the boiler. This heating is sometimes done by the hot waste gases from the boiler. To attain the best results\* high superheating in a special superheater is necessary, but unfortunately for many years serious difficulties, partly in the superheater and partly in the engine, presented themselves in the practical application of highly-superheated steam. The construction of the engine was unsuitable for such high temperatures, and the lubricants were decomposed. Now, however, these difficulties have been overcome.

A very efficient and economical engine on the 'Schmidt' system, and made by Messrs. Easton & Co., is shown in fig. 3, Pl. I. The steam consumption of this engine, working with steam superheated to 660° F., is only 11 lbs. per I.H.P. per hour. The engine is single-acting compound condensing, with high-pressure cylinder 16 inches in diameter, low-pressure cylinder 21 inches in diameter, stroke 20 inches. With steam at 160 lbs. pressure, and running at 120 revolutions per minute,

# STEAM-ENGINE.—IV.

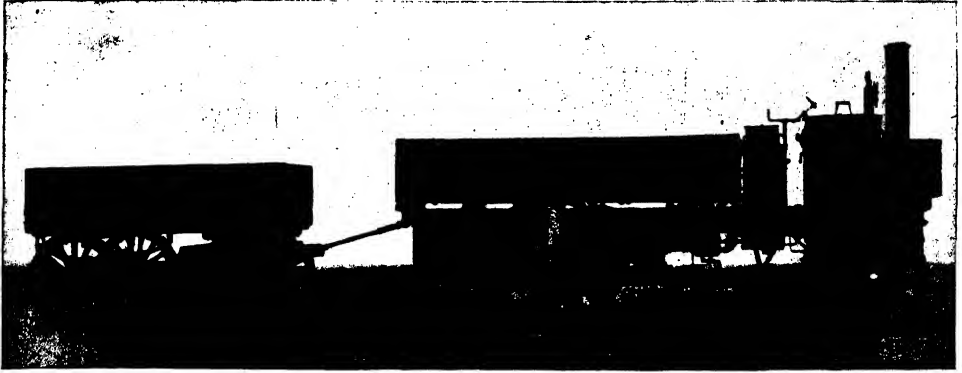


Fig. 1. Thornycroft Steam-wagon.

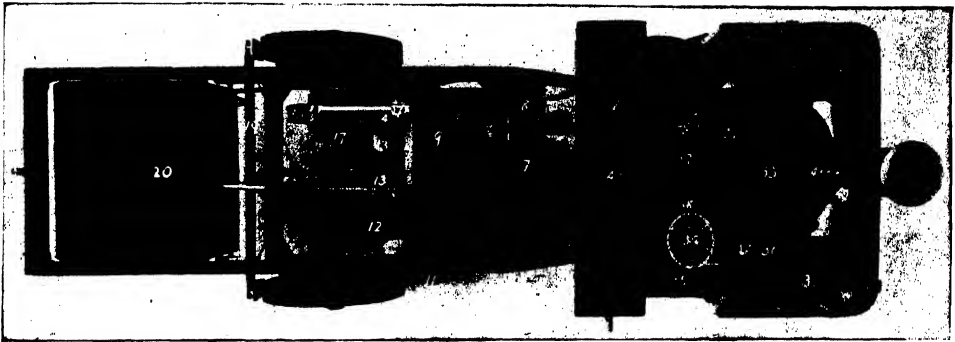


Fig. 2. Thornycroft Steam-wagon Mechanism, viewed from above.

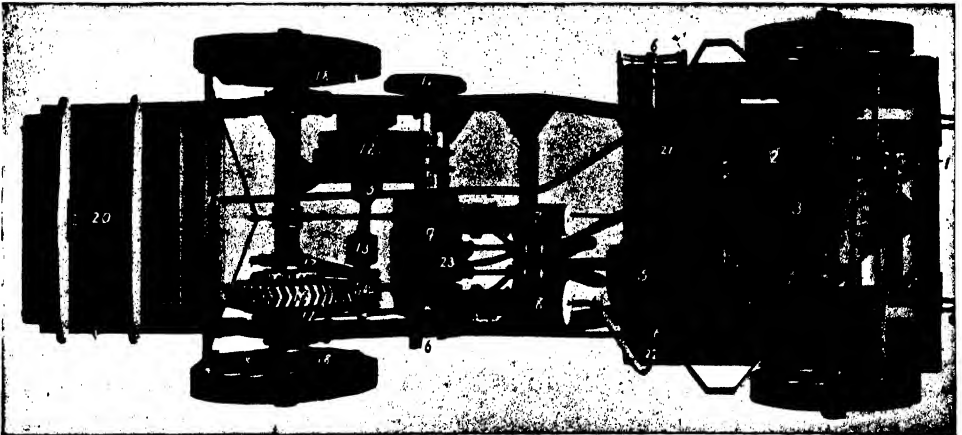


Fig. 3. Thornycroft Steam-wagon Mechanism, viewed from underneath.

## THORNYCROFT STEAM-WAGON. Index of Parts, Figs. 2 and 3.

1. Steering-gear, on divided-axle principle, through a worm and quadrant.
2. Bottom of Boiler.
3. Ash-pan.
4. Front Axle, fixed.
5. Exhaust-box and Feed-water Heater.
6. Reversing Lever and Gear.
- 7, 8. High- and Low-pressure Cylinders.
9. Engine Casing.
- 10, 12. Speed-gear.
11. Fly-wheel.
13. Double Universal Joint-coupling.
- 14, 15. Double Helical Spur-wheels, carrying differential gear.
16. One side Crown Wheel of differential gear.
17. Bell-crank Arms and Rod, whose object is to insure that wheels 14, 15 maintain constant mesh or gear.
18. Driving-springs.
19. Brake-bar.
- 20, 21. Feed-water Tanks.
22. Injector for filling front tank.
23. Feed-pump, worked by worm-gearing from engine shaft.
31. Fuel Bunkers.
32. Boiler Top.
33. Firing-hole Cover.
34. Steering-wheel.
35. Steam-regulating Wheel.
36. Safety-valve.
37. Steam Lubricator Cup.
38. Water-gauge.
39. Feed Check-valve.
40. Feed-water Injector.
41. Steam Collector.
42. Pressure-gauge.
43. Tool-box, secured to seat.



this engine will develop 40 I.H.P. The arrangement of cylinders and valves in this engine is of special design. The cut-off is automatically controlled by a shaft governor.

**High-speed Engines.**—Of the various types of high-speed engines, the Willans 'central valve' engine is without doubt the one most extensively used for electric-lighting station work. This engine is single-acting, and on the 'constant-thrust' principle—that is to say, the connecting-rods are always in compression, never in tension. A section of a two-crank triple-expansion engine is shown in fig. 4, Pl. II. Each crank is driven by a complete engine—containing high-pressure, intermediate, and low-pressure cylinders, built up tandem fashion in a vertical line. The steam is distributed throughout by the hollow piston-rod, in which works a line of piston valves, operated by an eccentric on the crank-pin, and so arranged that the relative movement of these valves with respect to the hollow piston-rod determines the admission, transfer, and exhaust of the steam. There are two connecting-rods to each line of pistons, one on each side of the eccentric, and the crosshead itself is in the form of a piston.

Fig. 5, Pl. II. is an illustration of a three-crank triple-expansion Willans engine, which has been very generally adopted for electric-light stations. The diameters of the H.P. cylinders are 15 inches, I.P. cylinders 23·6 inches, L.P. cylinders 37·5 inches, the stroke being 17 inches. With steam at a pressure of 180 lbs. per square inch, and running at 230 revolutions per minute, this engine will develop 1200 I.H.P. It is shown coupled direct to a dynamo.

A double-acting, quick-revolution, self-lubricating, two-crank compound engine, by Messrs. Belliss & Morcom, is illustrated in figs. 1 and 2, Pl. II. In the 'Belliss' system the lubrication is effected by means of a simple pump without valves or packing, which delivers the oil to all the bearings at a pressure of about 15 lbs. per square inch through a specially-arranged system of oil channels. By using forced lubrication it is possible to obtain with double-acting engines quiet running at high speeds of revolution. The oil as it escapes from the bearings drains into the crank-pit, and is used over and over again. The illustration shows two views in sectional elevation of the 'Belliss' engine; it will be seen that only one piston-valve is used, arranged between the high and low-pressure cylinders, and operated by a single eccentric; s and x are the steam and exhaust passages respectively—the arrows show the course of the steam. The cranks are set opposite to each other, and the steam is admitted simultaneously to the top of one cylinder and the bottom of the other. The governor, which is placed at the end of the crank-shaft, is of the centrifugal type, and controls the speed of the engine through an equilibrium throttle-valve; the speed can be adjusted by hand while the engine is running. 'Belliss' engines are largely used for electric-lighting, power, and traction.

Another type of double-acting, high-speed, two-crank compound engine with forced lubrication, made by Messrs. Browett, Lindley, & Co., is shown in fig. 3, Pl. II., coupled direct to a dynamo. The valves to both cylinders are of the piston type, and there is an automatic expansion-shaft governor which controls directly the cut-off valve of the high-pressure cylinder.

**Portable Engines.**—In this type the boiler and the engine necessarily go together; the boiler forms a foundation for the engine, the whole of which is placed on the top of the boiler, whilst the boiler is supported on four wheels, on which it is drawn by horses from place to place. A kind of engine, known as semi-portable, is precisely of the same type as the

portable, but instead of being equipped with travelling wheels is mounted on a cast-iron frame, forming an ash-pit at the fire-box end. Axle plates and turn-plate are usually fitted, so that a semi-portable engine can be readily converted into a portable type either temporarily or permanently by attaching suitable wheels and axles. A type of semi-portable compound engine, by Messrs. Marshall, Sons, & Co., is given in fig. 1, Pl. III. The cylinder and valve-chest are cast in one piece, which is rigidly mounted on the boiler at the fire-box end. The crank-shaft bearings are attached to carriages, which can slide in dove-tailed castings bolted to plates riveted to the boiler. The cylinder casting is attached by longitudinal stays to these carriages, which permit the boiler to expand and contract without affecting the positions of the cylinders and crank-shaft. The engine illustrated is fitted with a Hartnell governor and automatic expansion gear, also a jet condenser. The feed-water is contained in a cistern under the smoke-box, and can be heated by means of the exhaust steam, which passes through a copper coil contained in the cistern.

A compound steam-ploughing engine, by Messrs. Aveling & Porter, is shown in fig. 2, Pl. III. Two such engines are generally used; one engine at each end of the furrow alternately pulls the plough towards it by means of a steel rope and winding-drum placed underneath the boiler, while the other moves forward into position ready for its return.

A compound steam road-roller by Messrs. Aveling & Porter, and fitted with Morrison's scarifier for breaking up old roads preparatory to repairs, is illustrated in fig. 3, Pl. III.

One of the most successful types of steam vehicles is that made by the Thornycroft Steam Wagon Company, which is represented in fig. 1, Pl. IV., by a steam wagon capable of carrying 3 tons, and drawing a further 2 tons on a trailing vehicle. This wagon gained the first prize at the War Office trials of self-propelled lorries for military purposes in 1901, and several were supplied for use in South Africa. The general arrangement of engine, boiler, gearing, &c., of a standard steam wagon as viewed from above, is shown in fig. 2, while fig. 3 is a view of the same as seen from underneath. The engine is a two-cylinder compound of 4 and 7 inches diameter respectively by 5 inches stroke, running normally at about 450 revolutions per minute in fast gear, at which speed it develops about 20 B.H.P. The engine is fitted with piston-valves, and is entirely inclosed in a dust-proof and oil-tight case. When in hill-climbing gear, the speed of the engine may increase to about 660 revolutions and the B.H.P. to about 30. The valve-gear is a single eccentric modification of Sohns' arrangement, permitting of reversing and any degree of linking-up. The boiler is made up of two annular rings, connected by straight steel tubes  $\frac{3}{4}$  inch in diameter. It is fired from the top through a central shoot, ordinary gas-coke being generally used as a fuel. The heating surface is 83 square feet, and the working pressure 200 lbs. per square inch. The complete engine is suspended from the wagon-frame from three supports. The gearing is of machine-cut steel, and drives the road wheels by means of a spring driving-apparatus, which prevents the transmission of the road shocks to the gearing, and greatly reduces the wear and tear. The springs are clamped to the axle, the wheels themselves being free, and the outer ends butt against stops on the felloes of the wheels, so that no driving strain at all is transmitted through the spokes. Water is supplied to the boiler from a tank under the seat, and there is a reserve tank at the back underneath the wagon-frame. These

wagons can easily maintain on average roads a speed of 5 to 7 miles per hour, and one man is able to easily perform all the operations required in driving and controlling the vehicle.

**Marine Engines.**—The arrangement of the parts of a marine engine differs in some respects from that of a land engine. The limitation of space, which is unavoidable in a vessel, renders greater compactness necessary. The early marine engines, at the beginning of the nineteenth century, were constructed similar to Watt's engines. The manner in which the steam-engine is applied to the propulsion of vessels is in its general features familiar to most people. As applied to the turning of paddle-wheels, a shaft is carried across the vessel, being continued on each side so as to overhang the vessel and carry a paddle-wheel at each end. The paddle-wheels have attached to their rims a number of flat boards or floats, which, as the wheels revolve, strike the water, driving it in a direction contrary to that in which it is intended the vessel should be propelled. The moving force imparted to the water thus driven backwards is necessarily accompanied by a reaction upon the vessel through the medium of the paddle-shaft, by which the vessel is propelled forwards. Although the paddle-wheel has been almost entirely superseded by the screw-propeller in sea-going ships, it is still used in river steamers, and in sea-going vessels of large power and light draught of water. The paddle-shaft is usually provided with two cranks at right angles to each other, and driven by two steam-engines, which are placed in the hull of the vessel below the paddle-shaft.

Modern paddle-wheel engines are usually *oscillating-cylinder engines* or *diagonal engines*. In *oscillating-cylinder engines* the cylinders are placed immediately below the shaft, and the piston-rod is connected direct to the crank-pin. The cylinders are supported on trunnions, which permit of the necessary freedom of oscillation to follow the motion of the crank. Steam is admitted through the trunnions to slide-valves on the sides of the cylinders. The *diagonal* or *inclined direct-acting engine* is the type now generally adopted.

A modern set of paddle-wheel engines are shown in fig. 4, Plate III. They were designed and constructed by Messrs. Denny & Co. for the *Lord Warden*, running on the Calais and Dover service. The engines are triple-expansion, having cylinders  $35\frac{1}{2}$  inches,  $52\frac{1}{2}$  inches, and 76 inches diameter, with a stroke of 6 feet; the boiler pressure being 150 lbs. per square inch. The covers of the surface-condenser and low-pressure steam-chest have been removed, and the double-ported slide-valve in the latter is clearly seen. The intermediate and high-pressure cylinders are fitted with piston-valves.

When the screw-propeller began to take the place of the paddle-wheel the increased speed which it required was at first supplied by using spur-gearing to connect the engine-shaft with the screw-shaft. It was soon found, however, that the engine-shaft could be connected directly to the screw-shaft without gearing, and the engines run at a sufficient speed for the screw without injury. This led to the use of fast-running engines placed horizontally. Many forms of horizontal screw-engines were tried for driving the screw-propeller of ships of war, in which it was an essential condition that the whole of the machinery should be located below the level of the water-line, free from the risk of damage from shot and shell. The horizontal position for the cylinder—on the same level as the screw-shaft—was the only position available consistently with this condition; and many arrangements have been employed in carrying out the principle of horizon-

ality consistently with compactness laterally, so that the machinery might be arranged within the limits of the hull of the vessel. These became reduced to three well-known types—the direct-acting engine, the return connecting-rod engine, and the trunk-engine. In the second type the piston-rods passed clear of the shaft and the crank, and were joined beyond it in a guided cross-head, from which a connecting-rod returned to the crank. In the trunk-engine, as constructed by Messrs. Penn & Son of Greenwich, a hollow cylinder or trunk is fixed to and reciprocates with the piston, and serves as a guide. The connecting-rod was attached to the interior of the trunk, at the middle of its length, within the cylinder, and by this means the lateral width of the engine was considerably reduced.

The type of marine engine now universal for both merchant ocean-steamers and naval practice is the inverted vertical direct-acting form. There are usually three cylinders set in line fore-and-aft above the shaft, working on cranks at  $120^\circ$  from one another. Triple or three-stage expansion is generally adopted, though recently quadruple-expansion engines have been employed. In marine engines of large power it is sometimes necessary to use two low-pressure cylinders; if arranged with three cranks, the high-pressure cylinder, and in some cases two high-pressure cylinders are placed tandem-fashion over the low-pressure cylinders. In other engines four cranks are adopted, as in those balanced on the Yarrow, Schlick, and Tweedy system, in which the cylinders are arranged with respect to the cranks in such a manner as to reduce vibration when running at high speeds. Two sets of triple-expansion engines balanced on the above system are shown in fig. 5, Plate III. The engines were designed and constructed for the twin-screw steamer *Arundel*, for the cross-channel service between Newhaven and Dieppe, by Messrs. Denny & Co., Dumbarton. Each set has four cylinders and four cranks, but working with three stages of expansion, the high-pressure being  $23\frac{1}{2}$  inches in diameter; intermediate,  $35\frac{1}{2}$  inches; and two low-pressure cylinders, each  $37\frac{1}{2}$  inches in diameter, all working with a stroke of 2 feet 3 inches. The arrangement in the ship from the forward end is: low-pressure, high-pressure, intermediate-pressure, and low-pressure. Steam is supplied at a working pressure of 160 lbs. per square inch. At full speed of 21 knots per hour the engines make 200 revolutions per minute. In the illustration the cylinder covers have been removed. Successful applications of Parsons' steam-turbine (see TURBINE in SUPP.) to marine propulsion have recently been made.

**STEAMER (or RACE-HORSE) DUCK** (*Micropterus brachypterus*), a South American duck, with short wings and little power of flight, but which, by the aid of the powerful legs, together with the wings, can pass swiftly over the surface of the sea.

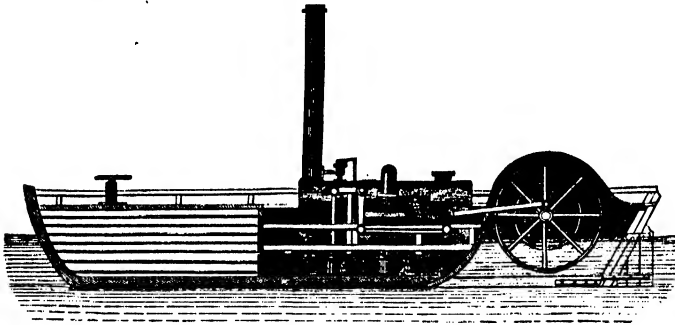
**STEAM NAVIGATION.** The steam-engine remained a useful but very imperfect piece of mechanism, till the self-educated genius of Watt breathed into it a new spirit. Scarcely had the fruit of the labour of Watt ripened, when its uses received that prodigious extension which resulted from its acquiring the locomotive character. Although, as early as 1737, Jonathan Hulls proposed to propel ships by steam, applying a paddle-wheel to the stern, the project was soon after abandoned, as there was no steam-engine better than Newcomen's available for driving the paddle. From 1785 to 1789 several competitors for the application of steam to navigation appear on the field. In America there were James Rumsey of Virginia, and John Fitch of

Philadelphia; in Italy, Serrati; and in Scotland, Mr. Miller of Dalswinton, in Dumfriesshire, whose experiments were by far the most conclusive of any that had yet been made. These were made on Dalswinton Loch in 1788, with a double or twin boat, fitted with a small engine made by William Symington, a practical engineer, and propelled by a paddle-wheel placed in the space between the twin-boats. With this they obtained a speed of about 3 miles an hour. The following year Mr. Miller constructed a larger boat, in which the engine propelled two paddle-wheels, one placed before the other, in the centre between the double boats. The engine in this case was made at the Carron Iron-works, and employed two atmospheric cylinders, each 18 inches diameter, with which a speed of 4 to 5 miles an hour was obtained on the Forth and Clyde Canal. This was in the autumn of 1789. After having thus completely established the practicability of the invention, even with the imperfect mechanism employed, Mr. Miller and his colleagues, Symington and Taylor, in the meantime abandoned the further prosecution of the subject, dreading perhaps the expense and opposition which usually falls to the lot of those bold spirits who dare introduce any innovation, however

Fulton received a full explanation of the machinery and working of the vessel from Symington, and was thus enabled to return with full information on the subject to his native country, where, in conjunction with a Mr. Livingston, he obtained a patent for what was termed their 'invention of steamboats.' His first attempt was made on the Hudson River, in 1807, with a steam-engine which had been sent out from England by Boulton and Watt, the plan of the wheels and gearing being similar to that introduced by Symington six years previously. With this vessel, which was the first American steamer, a speed of about 5 miles an hour was obtained. Fulton and Livingston then built several steamboats upon a larger scale for carrying goods and passengers, employing Boulton and Watt to make the machinery, which was still sent out from England.

Although steam navigation was thus early introduced on the American rivers, it was not until 1812 that the first regular steam passage-boat (of tiny dimensions, it is true) made its appearance in Great Britain, on the Clyde. This was the *Comet*, built for Henry Bell, the proprietor of the Helensburgh baths, on the Clyde, and who had been for long a most zealous advocate of steam navigation. The

little vessel was 40 feet long and 10 feet beam, with a steam engine of 4 horse-power on the bell-crank principle, the engine being placed on one side the vessel, and the boiler (of wrought iron) on the other. The *Comet* made its first voyage in January, 1812, and continued to ply regularly between Glasgow and Greenock at a speed of about 5 miles an hour. During this and the succeeding year two other vessels were constructed of an increased size and power; and in 1814 Mr. Cook, of



Section of the 'Charlotte Dundas' steamboat.

beneficial, on old established customs and prejudices. But Mr. Symington had not yet brought his labours in promoting steam navigation to a conclusion. In 1801 he was employed by Lord Dundas to construct a steamer for the purpose of towing barges on the Forth and Clyde Canal. This vessel, called the *Charlotte Dundas*, had a rotative engine on Watt's principle, with one horizontal cylinder 22 inches diameter and 4 feet stroke, with connecting-rod and crank, which turned a single paddle-wheel situated in a well-hole at the stern of the vessel. It was found to answer its purpose admirably, but the proprietors of the canal objected to its use, on account of the wash of the paddle-wheel, which, they alleged, would injure the banks. The boat was accordingly abandoned in 1802, after an expense of about £3000 had been incurred by the experiment.

We now come to the first introduction of steam into the river navigation of the United States. Shortly after the construction of the *Charlotte Dundas* an experiment was made with a steamboat on the Seine by Fulton, an American engineer, then residing in Paris, but the weight of the engine broke the vessel in two, and the whole was precipitated to the bottom. A second steamer was constructed by him, and launched on the Seine in 1803, but the rate of speed attained was so small as to have caused the undertaking to be regarded as a failure. In the same year he visited Scotland, saw Symington, and was taken a trip by him in the *Charlotte Dundas* on the Forth and Clyde Canal. At the same time

Glasgow, built a fourth, called the *Glasgow*, which, in point of power and efficiency, became the standard at that early period for the construction of river steamers. The kind of engine employed was the *bell-crank*, introduced by Boulton and Watt, with a crank on the main shaft, which turned the paddle-wheels on each side of the vessel. The boiler was of wrought iron with internal furnace, and flues surrounded with water.

The marine engines hitherto constructed were single, but in 1814 Messrs. Boulton and Watt applied two condensing engines, connected together by cranks set at right angles on the shaft, for propelling a small steamer on the Clyde. In 1815 a small vessel, with a side-lever engine of 14 horse-power by Cook of Glasgow, made a voyage from Glasgow to Dublin, and thence round the Land's End to London. It then ran with passengers between London and Margate with considerable success. In 1818 Mr. David Napier had the *Rob Roy* built by Denny of Dumbarton, with which he was the first to establish a regular communication between two sea-ports,—namely, Greenock and Belfast. The *Rob Roy* was about 100 tons burden, and had a single engine of 30 horse-power. It was transferred in 1819 from the west coast to the English Channel, to run between Dover and Calais; and about the same time Mr. David Napier built the *Talbot* of 150 tons, and two engines of 30 horse-power each, to run between Dublin and Holyhead. The same year the attention of the admiralty was directed by Lord Melville and

Sir George Cockburn to the importance of steam-power for naval purposes; and the *Comet*, the first steam-vessel in the royal navy, was ordered to be built. In 1821 steam communication was first established between London and Leith.

The great triumph of steam navigation, the crossing of the ocean by steamers, had partly been achieved in 1819 by the *Savannah*, an American vessel of 300 tons burden, which made the voyage to Liverpool from the United States in twenty-six days; but though assisted by the agency of steam, her main progress had been made as a sailing-vessel. The first steamer proper to cross the Atlantic was the *Royal William*, which sailed from Nova Scotia to Gravesend in 1833. The great project of establishing a line of steamers between Great Britain and America was first announced in 1836. The *Sirius*, which started from London on the 4th of April, 1838, arrived at New York on the 22nd, being the first steamer which had crossed the Atlantic from Great Britain. She was followed on 7th April by the *Great Western* from Bristol, which arrived in New York on the 23rd. In the meantime a plan had been laid before government by Mr. Samuel Cunard, an American gentleman, for establishing a line of steamers for carrying the mails between Liverpool and Boston, touching at Halifax; and ultimately, with the aid of government, the Cunard line was established. In the navigation of rivers the employment of steamers has become universal.

Some of the more important of the world's steamship lines may be mentioned here. Among British lines, some of which have recently passed under American control, are the following:—Cunard Line, founded in 1840, Liverpool—New York, including the *Campania* and *Lucania* (1893); Elder, Dempster, & Co., controlling eight lines to America and Africa, the leading British steamship firm in point of tonnage; Peninsular and Oriental Steam Navigation Co., founded about 1837, carrying mails to India, China, and Australia; Pacific Steam Navigation Co., incorporated 1840, America (chiefly South) and Australia; Union-Castle Line, formed by an amalgamation in 1900, South Africa; White Star Line, founded 1869, chiefly Liverpool—New York, including some very large vessels, such as the *Oceanic* (1899), *Celtic* (1901), and *Cedric* (1902), the last the largest steamship hitherto built; Wilson Line, founded 1835, Baltic trade, India, America; Leyland Line, to North America; Allan Line, with which the State Line is incorporated, founded 1854, to Canada; Anchor Line, to America (New York), Bombay, and Calcutta; British India Steam Navigation Co., incorporated 1856, carrying mails to Arabia, Persia, India, Mauritius, &c.; and the Clan Line, founded 1878, to Africa and India. The principal foreign lines are:—Hamburg-American Line, founded in 1847, the largest in the world, including the *Deutschland* (1900), the fastest ocean steamer in the world; Norddeutscher Lloyd (Bremen), founded in 1856, to America, including the *Kaiser Wilhelm der Grosse* (1897), *Kronprinz Wilhelm* (1901), and the *Kaiser Wilhelm II.* (1902), the largest express ocean steamer in the world; Messageries Maritimes de France, founded 1851, Mediterranean, India, Pacific, Africa, &c.; Compagnie Générale Transatlantique, founded 1862, Havre to America and Africa; American Line, incorporated 1871, including the former Inman Line, head-quarters Philadelphia; Austrian Lloyd, founded 1866, belonging to Trieste.

An important feature in the history of steam navigation is the introduction of the screw as a propelling power, instead of the paddle-wheel, by which it has been extended in a manner and to a degree at one time little thought of. While the

screw competes with the paddle-wheel in rivers and lakes in the speed with which by its aid vessels are propelled through the water, its greatest development has taken place in the navigation of the great oceans. For long voyages the screw has entirely displaced the paddle, and all the largest vessels of recent construction are fitted with twin-screws and a double set of engines. (See SCREW-PROPELLER.) A further development of great importance is the introduction of the steam-turbine into screw-vessels. See TURBINE in SUPP.

The increase in the number of steamboats since the time when the *Sirius* first crossed the Atlantic has been very great. Whereas in 1814 the United Kingdom only possessed two steam-vessels, together of 456 tons burden, in 1901 there were on the register of the United Kingdom 7161 steam-vessels of 100 tons and upwards, of which the gross tonnage amounted to rather more than 12,000,000 tons, or about half the whole steam-tonnage of the world. The steam-tonnage of the United States was then slightly more than 1,700,000; that of Germany was over 2,400,000; and of France, fully 1,000,000 tons. As the number of steamboats has greatly increased, so also has their size, and even the gigantic *Great Eastern* has been surpassed, not only in length, but also in tonnage, by vessels of immensely greater practical value. See SHIP.

Some account of the steam-engines employed for propelling ships has been given under STEAM-ENGINE.

STEAM AND POWER HAMMERS. The steam-hammer is a machine extensively employed in malleable iron-works in the forging of wrought-iron cranks and shafts for marine and land engines, in the manufacture of armour plates, &c., and in the smiths' shops of all the principal engineers, ship-builders, and railway companies both in Great Britain and in foreign countries. So far back as the year 1784 James Watt obtained a patent in which he specified a steam-hammer, and although not carried into practical operation by him for the very good reason that there was no demand at that date for such a tool, yet he is clearly entitled to the merit due him as the original inventor of the steam-hammer. The part of his specification relating to the steam-hammer is as follows:—'My fifth new improvement consists in applying the power of steam or fire engines to the moving of heavy hammers or stampers for forging or stamping iron, copper, and other metals or matters, without the intervention of rotative motions or wheels, by fixing the hammer or stamper to be so worked either directly to the piston or piston-rod of the engine, or upon or to the working beam of the engine, or by fixing the hammer or stamper upon a secondary lever or helve, and connecting the said lever or helve by means of a strap or of a strong rod to or with the working beam of the engine, or to or with its piston or piston-rod'. In 1806 a second patent was obtained by William Deverell, which was also to 'work by the direct application of steam without the intervention of wheels, pinions, or any rotative motion'. With the wonderful progress made in steam navigation, railways, and various manufactures during the succeeding years, there arose a demand for larger articles of wrought iron, and James Nasmyth, the Scottish engineer, designed in 1839, and patented in 1842, a direct-acting steam-hammer, which immediately came into extensive use. The first steam-hammer actually constructed was that set up in the works at Creuzot in 1841 by the chief engineer of those works, M. Bourdon, who had seen Mr. Nasmyth's plans on the occasion of a visit made by him to the establishment of the latter near Manchester. In the hammers patented by Watt, Deverell, and Nasmyth the hammering weight is attached to the

lower end of the steam piston-rod, and the shock of each blow being communicated to the piston and piston-rod caused frequent and very serious breakages of these parts of the machine. In 1846 John Condie took out a patent for a steam-hammer entirely different from those previously mentioned, and intended to obviate the evils referred to. The great improvement in Condie's steam-hammer consists in the fact that the steam-cylinder is movable, and bears the hammer face dovetailed into it at its lower end, whilst the piston and its rod are fixed to the framing. The steam is introduced into the cylinder above the piston, and pressing against the cylinder cover raises the hammer between guides to the required height. An exhaust valve is then opened, allowing the hammer to fall not only with the force of gravity, but when it rises to the full height, with the additional impetus derived from the compression of the air under the piston. With the most powerful hammers steam is also introduced on the under side of the piston so as to augment still further the speed and force of the blow. The valve gearing is so arranged that the attendant can arrest the motion of the hammer whilst it is falling, or cause it to fall at any moment while it is ascending. Light and heavy blows may thus be given at will. The credit of contriving the mechanism for this purpose belongs to Mr. Wilson, the head engineer of Mr. Nasmyth's establishment. For light hammers the framing consists of a single iron standard, the upper part of which, supporting the hammer and containing the guides in which it works, comes forward so as to admit of the anvil being placed directly beneath the hammer. The heavier steam-hammers, on the other hand, are supported by two standards meeting at the top, and the anvil lies between the two. When the hammer is a very heavy one the standards are made of wrought iron. Condie's hammer was successful beyond the inventor's most sanguine expectations, and when the specifications for the immense shafts and cranks required for the paddle-engines of the *Great Eastern* were issued the 6-ton hammer made by him in 1853 for Messrs. Fulton and Neilson of Lancefield Forge, Glasgow, was selected for that purpose on account of its great power and excellent arrangement of framing, which allowed the workmen easy access to all sides of the anvil. Since that date very much larger hammers have been erected. Specially powerful hammers are required for the manufacture of the enormous forgings which have now to be made for heavy ordnance, propeller-shafts, and other purposes. At Woolwich a hammer was erected having a weight of about 40 tons, the height of fall being over 15 feet. With steam introduced to assist the downward stroke it has a striking force equal to what a height of 80 feet would give. An 80-ton hammer was erected at the Creuzot iron-works in France. By 1885 a 100-ton hammer was in operation at the Cockerill works, Seraing (Belgium), and in 1888 Krupp at Essen erected one of 150 tons. Even heavier hammers have since been made, and on the other hand comparatively light ones capable of giving an enormous number of strokes per minute.

Several modifications have been made in the application of Condie's moving-cylinder principle in the design of steam-hammers. In Neilson's and Wilson's radial hammers the cylinder is supported at some distance from the base of the standard, and may be turned round in an arc of a circle (in Wilson's round the circumference of a complete circle, with a radius of 6 feet from the centre of the base of the standard). Such hammers are used for light but complicated forgings, the anvil block bearing dies of various form. In Ramsbottom's hammer two hammer-cylinders move horizontally in the same line but in opposite

directions, and the piece to be forged is placed between the two. Steam must of course be used in this case for propulsion as well as for retraction. This form of hammer admits of the anvil being dispensed with, but sometimes it is combined with the descending hammer so that a piece is compressed on four sides at once. There are some other kinds of steam-hammers suitable for light work besides those on Condie's principle. In most of these the hammer head is attached to the end of a horizontal shaft which acts as a lever, the fulcrum of which is nearer the free end of the shaft than the end bearing the hammer, and the hammer is raised by cams attached to a revolving drum, and falls when by the revolution of the drum the shaft is freed from one of the cams. An ingenious machine applying the principle of Nasmyth's hammer was invented by Mr. Nasmyth himself for pile-driving, and has been found of immense service for the purpose for which it was designed. The machine is constructed like a carriage, and moves upon rails, and besides lifting and letting fall the weight which drives the pile contains apparatus for picking up the piles in succession, hoisting them in the air, dropping them in their place, and guiding them while being forced into the ground. This pile-driving machine will sink about 300 piles in the time that it took by the old method to sink one, and it will do this without injury to the piles, the heads of which by the old method were completely shattered.

There are two kinds of power-hammers besides those driven by steam, the hydraulic and the pneumatic—the former having a head connected with a piston acted on by hydraulic pressure, while in the latter compressed air is the force employed.

**STEAM-PLOUGH.** The first steam plough was the invention of Richard L. Edgeworth, and was patented in 1770, long before any necessity for such a machine existed. Edgeworth's invention never received any practical application, and more than sixty years appear to have elapsed before the attention of agriculturists was again turned to the possibility of ploughing, with economical advantage, by steam. A patent for an improved apparatus, with this object, was taken out by Mr. Heathcote in 1832, but this invention also failed to yield practical results. From this date, however, numerous methods for ploughing by steam were devised, and some of those invented within twenty years of the date last mentioned, put into actual operation in the work of farming. Yet none of them presented such advantages over the ordinary method of ploughing as to bring them into anything like general use, or even to cause them to be used by any but their immediate patrons. In almost all of them the engine supplying the moving power accompanied the ploughing implement over the field, and when this is the case the loss of power is too great for the machine to be profitably employed. The first invention that has proved to be of economic value is that of Mr. John Fowler, who, in 1852, employed a stationary steam-engine to drag a draining-plough, which was connected with it by a rope. In subsequent years he worked out this invention for ordinary ploughs, and in 1856 received for it the gold medal of the French Agricultural Exhibitions. Since that date this machine, or others contrived by the same inventor on the same principle, have been awarded prizes almost every year by all the chief agricultural societies in this country, as well as several on the continent of Europe and in other parts of the world. In 1860 a machine of his gained the prize offered for steam-ploughs by the Royal Agricultural Society, on the occasion of their show held at Canterbury, and the machine then stood the severe tests to which all the competing machines were put, in such a manner as thoroughly

to establish its practical value. Fowler's steam-ploughing apparatus is made according to four different systems, each of which has its own advantages. In the first system there are two portable engines, one of which is stationed on each side of the field to be ploughed, and the ploughing implement is drawn from one to the other alternately, by means of a chain of hard steel rope. The first cost of the apparatus made on this system is greater than that of any of the other systems, but the system has these two great recommendations above all the others, that the two engines can transport themselves and all the rest of the apparatus to where they are wanted, without any additional manual or animal labour, and can be set to work, without loss of time in making preparations, as soon as they have reached their destination. In the second system there is only one engine, which is stationed on one side of the field, while on the opposite side of the field there is an 'anchor,' which forms the point of resistance for the steel rope which pulls the plough. This anchor is a sort of heavy carriage, with a horizontal wheel round which the chain turns, and resting on four thin disk wheels, which sink in the ground so as to prevent the anchor from being dragged sideways by the strain of the rope, but on which it may move forwards when necessary. In the third system the apparatus is so constructed that it may either be worked in the same way as in the second system, or with the engine stationed in one corner of the field, snatch-blocks being used to guide the rope attached to the plough. In the fourth system the engine is always stationed in a corner of the field, and the ploughing instrument is drawn between two anchors on opposite sides of the field. In all cases the ploughing instrument has several shares for different furrows. It is, likewise, always double, having similar sets of shares before and behind, and is so constructed that when the one set of shares is in the ground, the other set is high in the air. This arrangement obviates the necessity for turning. As steam-ploughing apparatus are usually beyond the means and beyond the requirements of single farmers, companies have been formed at various places for hiring them out to all who want them.

**STEARIC ACID**,  $\text{C}_{18}\text{H}_{36}\text{O}_2$ . This acid may be prepared from many of the natural fats, animal or vegetable, by saponifying the stearine which they contain with lime, and decomposing the calcium stearate so produced by means of dilute sulphuric acid. On the large scale stearic acid is prepared by decomposing fats by means of superheated steam. Stearic acid is a white, crystalline substance, melting at  $69^\circ$ ; it is when pure inodorous and tasteless; it has a distinctly acid reaction, and forms a number of salts, of which the best known are ordinary soft soap (potassium stearate) and hard soap (sodium stearate). See SOAP.

When stearic acid is heated to  $200^\circ$  in oxygen it is completely resolved into carbon dioxide and water; it burns in the air with the production of these compounds and various hydrocarbons, and gives out a clear, white light, hence it is much used in making candles.

**STEARINE**, a fat obtained from mutton suet. The substances included under the name stearine are really three in number; they are all glyceric ethers, containing the radicle stearyl. The alcohol glycerine contains three atoms of replaceable hydrogen; when one of these is replaced by stearyl we obtain

$\text{C}_2\text{H}_5$   
mono-stearine,  $\text{C}_{18}\text{H}_{35}\text{O}$  }  $\text{O}_2$ ; when two are replaced  
 $\text{H}_2$   
by the same radicle, di-stearine,  $\text{C}_{17}\text{H}_{33}\text{O}_2$  }  $\text{O}_2$ , is

produced; and when three atoms of hydrogen are replaced we obtain tri-stearine,  $\text{C}_{16}\text{H}_{27}\text{O}_3$  }  $\text{O}_2$ . The last-named substance is that which is obtained from mutton suet; the two former substances are produced by heating glycerine and stearic acid together in sealed tubes. Tri-stearine may be prepared by melting mutton suet, adding an equal quantity of ether, pressing the fat which crystallizes from the ethereal solution when cold, and recrystallizing repeatedly till the melting-point of the fat is constant at  $62^\circ \text{O}$ . Tri-stearine forms white, pearly nodules, mixed with fine needle-shaped crystals; it is without odour, taste, or action on test-papers; it is a non-conductor of electricity. The melting-point of tri-stearine alters with the temperature to which the fat is subjected; as prepared from mutton-fat by crystallization from ethereal solutions, tri-stearine melts at  $62^\circ$ ; but if this modification be heated to  $65^\circ$  or  $66^\circ$ , and allowed to solidify slowly, it forms a friable, crystalline mass, which does not melt below  $69^\circ\text{--}7^\circ$ . If this be now heated to  $78^\circ\text{--}7$ , and then cooled, it does not solidify until the temperature falls to  $51^\circ\text{--}7$ , and the melting-point is now found to be  $52^\circ$ . Stearine is now largely employed in the manufacture of candles. For this purpose mutton or beef tallow, palm-oil, and different kinds of fatty matters are employed. The fatty matter is either heated for some time with strong sulphuric acid, then washed with water, and finally distilled; or it is subjected to the action of superheated steam, under a considerable pressure, and afterwards distilled. The object of these processes is to decompose the stearine (and other fats, for example, palmitine, oleine, &c.) into glycerine and stearic acid, and to separate these products from one another. Stearic acid, which is a solid substance, is the material of which the so-called stearine candles are composed. See STEARIC ACID.

**STEATITE** (soap-stone), a silicate of magnesium and aluminium. All the varieties of steatite are so soft that they may be easily cut by a knife, and in most cases scratched by the nail. Its powder and surface are soft, and more or less unctuous to the touch. It is seldom translucent, except at the edges. Its fracture is, in general, splintery, earthy, or slaty, with little or no lustre. Exposed to heat, it becomes much harder, but is almost infusible by the blowpipe. Its colour is usually gray or white, variously mixed with green, yellow, or red, and is sometimes a pale yellow, red, or green, of different shades. Its specific gravity is usually between 2.65 and 2.80. It occurs in masses or veins, or small beds, in primitive and transition rocks, more particularly in serpentine. From its softness and tenacity, which enable it to be cut or turned into various forms, and its property of becoming hard by heat, steatite is a useful mineral. It is employed for the hearths of furnaces, the sides of fireplaces and stoves, &c. It has a great affinity for glass, and, reduced to a fine powder and mixed with colouring matters, it is used for painting on this substance. It readily unites with oils and fats, and enters into the composition of the balls employed for cleaning silks and woollens. It is used to give lustre to marble, serpentine, &c., and, mixed with oil, it serves to polish metal and crystal. Steatite is also used in the preparation of glazed paper. It facilitates the action of screws, and may be employed for diminishing friction in machinery. Steatite is one of the varieties of *talc* (which see).

**STEEL**.—The term steel as now used includes such a wide range of materials that it is almost impossible to give a satisfactory definition. It may be sufficient to say that steel is an alloy of iron and carbon, with small quantities only of other impurities, the quantity of carbon varying in most cases

from 0·1 per cent to 1·5 per cent, though in exceptional cases it may be either lower or higher. Steel may for convenience be divided into two classes, though there is no sharp line of demarcation between the two, but the one passes gradually into the other: (1) Hard or tool steel, iron containing from 0·5 to 1·5 per cent of carbon. Its most important characteristic is that it becomes hard when heated to redness and quenched in water. And (2) mild or structural steel, containing from 0·1 to 0·5 per cent of carbon, which does not harden sensibly on quenching from redness. The two varieties are used for quite different purposes, and, as a rule, are made by different processes.

**Hard or Tool Steel.**—This, until the invention of the Bessemer process, was the only material known as steel. The hardness increases with the quantity of carbon, and many grades or tempers are therefore made. The following is a list of the grades usually made, with the percentage of carbon:—For razors,  $\frac{1}{2}$  per cent; for files,  $\frac{1}{8}$  per cent; for turning tools, &c.,  $\frac{1}{4}$  per cent; for large turning tools, dies, &c.,  $\frac{1}{2}$  per cent; for cold chisels, 1 per cent; for sets, wood-chisels, &c.,  $\frac{3}{4}$  per cent; for dies, &c.,  $\frac{1}{2}$  per cent; for springs, &c.,  $\frac{1}{4}$  per cent.

The higher the percentage of carbon the harder is the metal, the greater its tensile strength, and the more difficult it is to work or weld. The more carbon also the harder, and at the same time the more brittle does the metal become when quenched, so that the harder steels are used for cutting-instruments where a keen edge is required with but little strength, whilst the softer are used for articles where strength is important.

When an article of steel is quenched in water (or oil or mercury) it becomes very hard and brittle; too hard, in fact, for use. The hardness must, therefore, be reduced to some extent, and this is done by the process called tempering. The article is heated to a moderate temperature, far short of that to which it was heated before quenching, and is then cooled in water. This operation reduces the hardness and brittleness to some extent, and the higher the temperature to which it is heated the greater is the reduction of hardness. The temperature is judged by the appearance of the metal. As it is heated the surface of the iron becomes covered with a film of oxide, and as the temperature rises it changes in colour, passing through all shades from yellow to purple as the temperature rises from 220° C. (428° F.) to 316° C. (600° F.), the higher temperature being short of visible redness. By watching the steel, therefore, the workman knows exactly when to withdraw it from the furnace to attain the hardness required. The accompanying plate gives a good idea of the scale of colours seen. Mild steels behave very differently. They are not sensibly hardened by sudden quenching, though no doubt a molecular change is produced. They are malleable at a red heat, can be rolled or hammered into the required form, and can be welded. The milder the steel the lower is its tensile strength, and at the same time the greater its plasticity or elongation before fracture, and therefore the less its brittleness. The following will give an idea of the steels used for various purposes:—

Carbon,	·05 to ·07 per cent—very mild steel for electric conducting-wires.
"	·09 to ·12 per cent—soft wire rod; steel for tin plates.
"	·14 — per cent—rivets.
"	·18 to ·19 per cent—boiler plates.
"	·11 to ·17 per cent—ships' plates.
"	·17 — per cent—girders.
"	·23 to ·30 per cent—railway axles.
"	·30 to ·40 per cent—rails.
"	·45 to ·50 per cent—locomotive tyres.

In practice the tensile strength which the steel must bear, and the elongation on an 8- or 10-inch test-piece before fracture takes place, is usually specified. It is impossible to make steel which shall contain absolutely nothing but iron and carbon, though the nearer the steel approaches this the better. The impurities likely to be present are silicon, manganese, phosphorus, and sulphur. All these tend to harden the metal and decrease its plasticity. The two first-named do not seem to be objectionable if present only in very small quantities, but the two last always injure the steel. Phosphorus, whilst having little effect on the tensile strength when present in moderate quantity, renders the metal very much more brittle under shock or suddenly-applied stress, and the higher the carbon the greater seems to be its effect. It is therefore a most objectionable constituent in all varieties of steel. Sulphur seems to have little effect on the properties of the metal in the cold, but makes it 'red short' or brittle when hot, so that it is very difficult to work. Mild steel is usually stronger and tougher than malleable iron of the same carbon content, but it never shows the fibrous fracture so characteristic of the iron. The very mild varieties can be welded as easily as malleable iron.

**Preparation of Steel.**—Steel may be made in many ways. (1) Direct from the ore, by processes similar to the direct processes for the preparation of iron, the spongy metal being left longer in contact with the carbon. This process is not now used. (2) By the partial removal of the carbon, as in puddling, but stopping the process when a certain percentage of carbon is left (this process is not used); or by a modification of the Bessemer process, in which the 'blow' is stopped before all the carbon is removed. (3) By carbonizing malleable iron by heating it in carbon. This is the cementation process, which is still used for the preparation of high-carbon steels. (4) By completely, or almost completely, removing the carbon and other impurities from molten pig-iron by oxidation, and then adding carbon in a suitable form to the required amount—the Bessemer and Siemens processes. These are largely used, principally for the production of mild steels.

**The Cementation Process.**—This is the old process, and is still almost exclusively used for the production of hard steel. The best bar-iron is used, rolled into bars about 3 inches wide and  $\frac{3}{4}$  inch thick. These are put into large stone boxes or chests, each capable of holding many tons, and are packed in granulated charcoal, the chest being then covered with a suitable covering to exclude air. The chests and their contents are slowly heated to full redness, this taking about two days, and are maintained at this temperature for from three to eight or ten days, according to the character of steel which is to be made. They are then allowed to cool, and the chests are unpacked. The bars are found to have undergone several changes: they have increased in weight by 1 per cent or so; and the surfaces, which were quite smooth when the bars were packed, have become covered with a large number of blisters, whence the metal in this condition is called 'blister steel'. When the bar is broken the fracture is very different to that of the iron bar, the metal having been wholly or partly cemented into steel. If a low-carbon steel is being made there will be some 'sap' or unaltered malleable iron in the centre, only the outer edge being steel; but if a higher-carbon steel is being made the bar will be steel through, that is, the whole will have been converted. Thus the solid carbon has been conveyed into the metal, though there is some uncertainty as to how the transference has taken place.

The blisters are due to the evolution of gas within the metal by the reduction of oxide or silicate of iron, which is always contained in malleable iron, and the gas being unable to escape, if near the surface exerts sufficient pressure to produce a bubble or blister.

**Shear-Steel.**—Blister steel is not homogeneous enough for use. The bars are therefore cut up, piled, heated, and hammered down under a hammer, thus constituting 'shear-steel'. The process being repeated gives 'double shear-steel'.

**Crucible Cast-Steel.**—Even shear-steel is not perfectly homogeneous. To make it so it must be melted. Crucible cast-steel was first made by Huntsman in Sheffield about 1770, and the industry is still almost exclusively confined to that district. The blister steel bars are broken up and melted in crucibles in a crucible furnace. The whole art consist in keeping the steel melted just long enough before pouring. If it be poured as soon as it is melted the ingot is porous and is of no use; if it be kept melted too long the metal becomes brittle. The period during which the steel is kept melted after fusion is called 'killing', and the steel when ready is said to be dead melted. The killing takes from half an hour to two hours. The porosity of the unkilld steel is no doubt due to the evolution of gas during solidification, and the change produced by killing seems to be due to the absorption of small quantities of silicon from the pot.

**The Bessemer Process.**—This process was invented by Sir H. Bessemer, and was first described in a paper read before the British Association at Bath in 1856. Soon afterwards the works of Bessemer & Co. were started at Sheffield, and the process came rapidly into use. At first Bessemer made hard or tool steel, but this was soon abandoned, as the demand for the material called mild steel, which was now made for the first time, became very great.

**Principle.**—The principle of the process as now conducted is very simple. Air is blown through molten pig-iron till all the impurities are burnt out, the oxidation of these impurities producing enough heat to keep the metal liquid even after all the carbon is removed. It is found that in this condition the metal, if poured, would be brittle or rotten, and unfit for use, owing to the absorption of oxygen. To remedy this, *spiegel-eisen* or ferro-manganese, which are alloys of iron, carbon, and manganese, is added. The manganese removes the oxygen as oxide of manganese, which passes into the slag; and at the same time the requisite amount of carbon is added to give the steel the required composition, and the metal is cast into moulds.

**The Plant.**—The iron has to be supplied in the liquid condition, and may be either melted in a cupola or brought direct from the blast-furnace. The vessel in which the operation is carried out is called a 'converter' in this country, or a 'vessel' in America. It is usually of the form shown in fig. 1, though this may be much varied. It is made in three parts, the middle or body a remaining permanently in position, whilst the top and bottom portions can be removed for relining. It is made of steel boiler-plate, about  $\frac{3}{4}$  of an inch thick, and is lined with ganister or some other refractory material. Round the body passes a strong iron band, the trunnion-ring, which carries the trunnions on which the vessel can be rotated. The one trunnion *M* is hollow, and communicates with a passage in the standard, by which air passes from the blowing engines, so arranged that the air can continue passing whilst the converter is rotated through at least 90°. From this hollow trunnion a blast-pipe *D* passes down the side of the converter and communicates

with an air-chest below. The bottom of the converter casing is provided with holes, through which pass the 'tuyeres'. These are clay cylinders, about 3 inches in diameter and 18 inches long, perforated with a number of holes. The bottom of the lining is made up to the level of the top of the tuyeres. The bottom of the air-chest is so fixed that it can be easily removed so as to allow of the replacement of a tuyere when necessary. The second trunnion carries a toothed wheel *H*, by which the converter can be turned over. In addition to the converter a ladle is required, which must be large enough

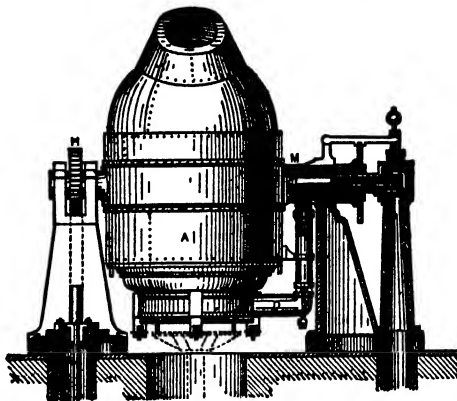


Fig. 1.

to hold all the metal, usually about 10 tons. This is carried on a ladle crane in a circular pit, round the circumference of which the moulds are placed, and is so arranged that it can be lowered under the converter to receive the metal and raised over the moulds so as to deliver it. The ladle is made of steel plates, lined with some refractory material, and is provided with an opening at the bottom, closed by a plug, worked from outside, so that the ladle can be brought over a mould, the plug raised to allow the molten steel to fill the mould, and then lowered till the ladle is brought over the next mould. Cranes are required to *strip* the ingots when solidified, that is, to lift away the moulds; to replace them for the next charge, and to lift away the ingots themselves; also suitable plant for carrying away the portions of the converter for relining and bringing up and placing fresh ones. The air is supplied at a pressure of about 15 to 20 lbs., usually by direct-acting horizontal engines.

**The Blow.**—The converter being ready, it is turned into the horizontal position, and the charge of say 10 tons of molten iron is run in from a ladle. It is essential that the converter should be so shaped that the metal lies clear of the tuyere holes, or when there is no blast on it would run into the holes and stop them. The blast is then put on, and the converter is slowly turned into the vertical position. As the metal flows over the tuyeres there is a vigorous projection of sparks, i.e. globules of molten iron. As the full depth of the iron comes over the tuyeres the shower of sparks diminishes, and the rush of air through the metal can be distinctly heard. At first there is very little flame visible at the mouth of the converter, but as the process goes on and the temperature rises a decided flame makes its appearance, which soon increases in size and brilliancy. At first it is very unsteady, then it becomes steady, bright, and dense. The intensity of the action then begins to diminish, the flame becomes less luminous and

diminishes in volume, and at last—about twenty minutes from the start in ordinary cases—it suddenly becomes much smaller, or drops, and the blow is over. Thus in about twenty minutes 10 tons of pig-iron will have been converted into mild steel. The converter is very promptly turned over, the blast is turned off, and the metal is poured into the ladle, the necessary amount of ferro-manganese being either thrown into the converter before pouring, or into the stream of metal as it flows into the ladle. The ladle is moved away, the converter is turned down so that some refractory slag which has not poured with the metal may be got out. It is then examined, and if no repairs are necessary is turned up, and is ready for the next blow. In the meantime the metal is run into the moulds, the slag emptied, and the ladle made ready for the next charge. As soon as the metal has set, the ingots are stripped, lifted away, and the moulds replaced. The converters are worked in pairs, so that immediately the blow is over in one, the other is moved up to start, and thus with two converters about 60 tons of iron can be made into steel in an hour. In America the process is worked much more quickly, the time of blow being about 10 or 12 minutes.

*Theory of the Process.*—As the air enters the iron, oxide of iron is formed, which is at once partially reduced by the silicon forming silicate of iron, which rises as a slag. Any manganese is also oxidized, and enters the slag. The carbon is then attacked. At first carbon-dioxide is formed, but as the temperature rises carbon-monoxide is produced, which burns at the mouth of the converter, producing the flame. The sulphur and phosphorus are not removed, and therefore pig-iron free from these elements must be used. The heat is produced by the oxidation of the silicon, carbon, manganese and iron, mainly by the two first. It is essential, therefore, that the pig-iron should contain about 2·5 per cent of silicon, or the blow may be too cold if there be too little, or too hot if there be too much.

*Swedish Process.*—In Sweden the process is still carried out in its original form. Swedish iron low in silicon is used, and the blow is stopped when it is judged that the carbon is reduced to the right amount, and the metal is poured. Steel is thus made containing as much as 1 per cent of carbon.

*The Basic-Bessemer Process.*—Since phosphorus is not removed in the Bessemer process, phosphorus-free pig-iron must be used, and thus the process was limited to those districts where ores suitable for making such iron occur or can be obtained. It was soon seen that the reason for the non-removal of the phosphorus was the siliceous lining of the converter, and that if, in place of this, lime or some similar basic material could be used, the phosphorus might be eliminated, but it was difficult to find a suitable material. The difficulty was overcome in 1877 by Messrs. Thomas & Gilchrist, and the process is therefore often called by their names, though more usually it is called the basic-Bessemer process, because it is the Bessemer process with converters lined with basic material.

The material used is magnesia-lime, made by burning magnesian-limestone (dolomite), which is a double carbonate of lime and magnesia, containing a small amount of silica. The lime is mixed with hot anhydrous tar, and is either moulded into bricks or rammed into the converter to form a lining. In making the bottom the material is rammed round a series of iron pins, which are afterwards withdrawn, leaving holes for the passage of the air. The plant used does not differ much from that used in the ordinary form of the Bessemer process, except

that the converters must be larger or the charges smaller, as a large amount of slag is produced.

The iron is melted and run into the converter as usual, about 10 to 15 per cent of lime being also added. The converter is turned up, and the blow commenced. The ejection of sparks is more vigorous than is the case of the ordinary blow, the flame is somewhat more luminous, and at the end there is evolution of red fumes, showing that iron is being oxidized. When the flame drops—when the carbon is all removed—the operation is not over, for the bulk of the phosphorus is still in the metal. The blow is therefore continued till this is removed, this being called the after-blow. There is no external indication of the end, so the converter is turned down and a sample is taken and examined. When the sample is satisfactory, the slag is poured off as completely as possible, the ferro-manganese is added, and the casting, &c., carried on in the usual way. It is necessary to pour off the slag before adding the ferro-manganese, or phosphorus would be reduced and pass into the steel.

The iron used should be low in silicon, not more than 1·5 per cent or there will be waste of lime, and should contain 3 or 4 per cent of phosphorus, the combustion of which will keep up the temperature at the end of the blow. Such pig-iron is made for the purpose, and is called 'basic-pig'. The slag contains a large quantity of phosphoric acid, and is ground and used as a manure.

*The Siemens or Open-Hearth Process.*—The Siemens process differs in many respects from the Bessemer. The furnace used (fig. 2) is a reverberatory furnace heated by gas, and the oxidation is brought about mainly by the addition of oxide of iron. The process became possible when Siemens perfected his regenerative furnace.

The fuel used is always producer gas (see FUEL). The furnace is provided with regenerators, *c.d.*, which are simply chambers filled with refractory fire-bricks set chequer-wise, so as to allow ready passage of the gas. There are four chambers provided with suitable valves (see fig.), so that they can be put in connection with the furnace or the chimney, and two with the gas main, and two with the air. When the furnace is at work, the air and gas for combustion are passed to the furnace through two of the regenerators, and the products of combustion pass to the chimney by the other two. Thus the one pair will be being cooled, giving up its heat to the air and gas, and the other will be being heated by the products of combustion. The direction of the gases is reversed about every hour, so that the regenerators are kept at a high temperature, and the gas enters the furnace at a full red heat.

The body of the furnace will be 20 to 30 feet long, and 12 feet or so broad. The roof is usually built to dip a little towards the middle. At each end are the gas and air ports for the admission of gas and air, the latter being above, and being extended so as to overlap the gas ports at each end. The bottom of the furnace consists of a layer of fire-bricks set on edge on an iron plate, and on this is the working bed about 18 inches thick of refractory sand. The bed is made to slope towards a tap-hole at the back of the furnace. There are usually six working doors, three on each side. The furnace is placed so high that a ladle on a suitable carriage can be run under the tap-hole to receive the metal, and it is built of very refractory fire-bricks.

The charge of pig-metal and scrap, which will amount to from 20 to 50 tons, is put on to the hearth of the furnace either by hand, or more rapidly by means of a charging machine. The charge soon melts, and during melting oxidation

takes place to some extent, so that a considerable amount of silicon is oxidized by the oxide of iron, and slag is formed. When the charge is melted,

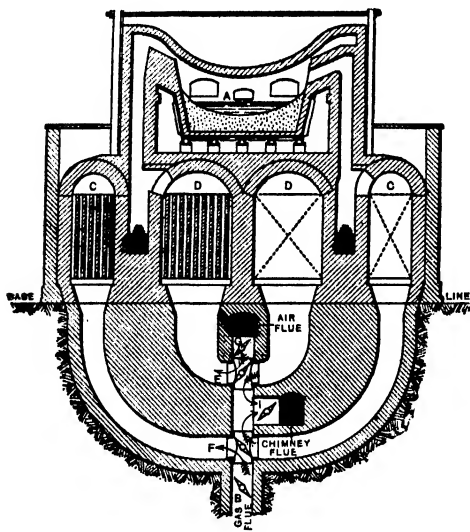


Fig. 2.

haematite is added and stirred in from time to time. When the silicon is to a large extent removed, the carbon is attacked, and the metal boils. When the boil ceases, a sample is withdrawn and tested. If the carbon is sufficiently removed the metal is tapped; if not, more ore is added. When the charge is ready, it is tapped into the ladle, the ferro-manganese is added, and the metal is distributed to the moulds. The time occupied will be from eight to twelve hours.

**The Siemens-Martin Process.**—If a large quantity of scrap be available the process can be carried on without the use of ore, enough pig-iron being added to compensate for the atmospheric oxidation. This form of process is called the Siemens-Martin process, and is the one that was first used.

**The Basic-Siemens Process.**—When it was found that phosphoric iron could be made to yield good steel in a basic-lined converter, it was thought that similar results might be obtained in the open-hearth steel furnace. The attempts were attended with great difficulty, owing to the fact that the materials that can be used for making basic bricks are not strong enough to build the roof of the furnace, so that both acid and basic materials must be used, and obviously these must not be allowed to come in contact. By the use of a parting layer of graphite or chromite, the difficulty has been overcome, and the basic open-hearth process has become a success. The furnace is lined with burnt dolomite or magnesite, and the charge is worked exactly in the same way as in the ordinary process, except that lime is added with the charge. Almost any pig-iron, provided it be free from sulphur, can be used, as the phosphorus is completely eliminated.

**Sulphur Removal.**—Sulphur is not removed by any of these processes; but by the Saniter process, which consists in treating either the iron as it comes from the blast-furnace, or on the hearth of the steel furnace, with a mixture of lime and calcium chloride, it may be to a large extent got rid of, and thus steel may be made from iron containing sulphur.

**Recent Modifications.**—The Siemens or open-hearth

furnace has been greatly modified during the last few years. The furnaces are now made of large size, holding 50 tons or more, and are sometimes made so that instead of being tapped in the usual way the body of the furnace is tipped or rolled over, so as to pour the metal out of a spout.

Two modifications have been made in the process with great promise of success. In the Bertrand-Thiel process two furnaces are used, the process being commenced in the one and finished in the other. In the Talbot process a large tipping furnace is used. The first charge of say 75 tons is worked in the usual way, and 25 tons is poured out, pig-iron is then added to bring the charge again to 75 tons, and when this is ready another 25 tons is poured off, and so on, a residue of metal being always left in the body of the furnace. By this means the working is much quicker, and a much larger output can be secured.

**Casting the Steel.**—The steel is cast from the ladle, which receives it from the furnace or converter, into suitable moulds. It may be cast either into the forms required for use, or it may be cast into ingots to be rolled down into the required forms. Great difficulty was experienced in obtaining sound castings, especially from very mild steel, owing to the fact that such steel dissolves a large quantity of gas which it gives off during solidification, and if this does not escape completely it makes cavities or blow-holes in the steel. This difficulty has been to a large extent overcome by the addition of small quantities of aluminium, which prevents the evolution of gas, and therefore ensures sound castings.

**Working the Steel.**—When the mould is removed the red-hot ingot of steel may be allowed to cool, but it is usually at once transferred to a 'soaking' furnace heated by gas, where it is left till it has acquired a uniform temperature all through. The ingot is then passed to the rolls, where it is rolled down into the required form, rails, bars, plates, &c. In the case of rails and billets the rolling is usually conducted at one heat, but in the case of plates the ingot is usually reheated once. The finished article is sheared to the required length or size, and is ready for the market.

**Theory of Steel.**—A great deal has been done within the last few years to elucidate the cause of the changes which take place when steel is heated and suddenly cooled, which have been already mentioned. Chemical analysis can give some help, but not very much, because by the methods necessarily used the proximate constituents of the metal are broken up by the solvents employed. This much has, however, been made out—that the carbon in steel exists in at least two forms. When a steel is cooled slowly, most, and in some cases all, the carbon is present in the form of a definite carbide ( $\text{Fe}_3\text{C}$ ) distributed through the mass of the metal; and when the steel has been hardened, most of the carbon is present in some form such that it is distributed through the whole metal, and cannot be isolated. Carbon in such a form is said to be present as hardening carbon, while that present as carbide is called carbide carbon.

The use of the microscope for the study of metals has of late been greatly developed, and the structure of iron and steel has been carefully examined. There are found to be four essential constituents, with others of importance, but which yet cannot be regarded as essential. The four are: (1) Ferrite, which is pure iron or iron combined with silicon or other constituent, and this forms the ground mass in the case of very mild steel. (2) Cementite, so-called from being present in cement steel, which is the carbide ( $\text{Fe}_3\text{C}$ ) mentioned above. (3) Pearlite, a

# S T E E L .

## COLOUR SCALE FOR TEMPERING TOOLS .

Saws for Wood,.....		Springs.
Screw Drivers, .....		Circular Saws for Metal,
Moulding & Planing Cutters } to be filed,..... }		Cold Chisels for Wrought Iron
Framing Chisels,.....		Hack Saw, Needles,
Firmer Chisels, .....		Cold Chisels for Cast Iron,
Saws for Bone and Ivory, .....		Cold Chisels for Steel,
Gimlets,.....		Edging Cutters,
Axes, .....		Drifts, Flat Drills for Brass,
Dental & Surgical Instruments, .....		Twist Drills,
Augers,.....		Stone Cutting Tools,
Coopers' Tools, .....		Half Round Bits, Reamers,
Wood Boring Cutters, .....		Punches and Dies,
Hand Plane Irons, .....		Chasers,
Gouges, .....		Taps,
Planing & Moulding Cutters, .....		Screw Cutting Dies,
Penknives,.....		Boring Cutters,
Rock Drills, .....		Milling Cutters,
Inserted Saw Teeth, .....		Planer Tools for Iron,
Leather Cutting Dies, .....		Planer Tools for Steel,
Wire Drawing Dies,.....		Slight Turning Tools,
Bone Cutting Tools, .....		Scrapers for Brass.
Wood Engraving Tools,.....		
Paper Cutters, .....		
Ivory Cutting Tools,.....		
Hammer Faces, .....		
Steel Engraving Tools,.....		



mixture of ferrite and cementite in alternate layers or masses. And (4) Martensite, a body which under low powers seems structureless, but which at higher magnification shows a feathery structure. This may be a solution of carbon in iron, but Arnold thinks it is a definite carbide ( $\text{Fe}_3\text{C}$ ).

The structure of steel depends on its composition, and on the way it has been treated. In general a steel which has been slowly cooled is made up of ferrite and pearlite, or of pearlite and cementite, whilst one which has been quenched is made up of martensite with a cementite, and other minor constituents. The behaviour of steel on cooling has led to the conclusion that there are three allotropic modifications of iron.

STEELE, SIR RICHARD, the earliest of our modern British essayists, and in humour and liveliness of style, unsurpassed by any of his successors, was born at Dublin in 1672, of a family of English extraction. He was educated at the Charterhouse, whence he removed to Oxford. He left the university without taking a degree, and (a thing not unusual at that time with needy young men of good connections) for some time rode as a private trooper in the dragoon guards. His frank and generous temper soon, however, gained him friends, and he obtained an ensigncy in the foot guards. Being led into many irregularities, he drew up and published a little treatise as a testimony against himself, entitled the *Christian Hero*, the seriousness of which excited much ridicule among his companions, his conduct falling far short of his theory. For this reason, as he himself observed, to enliven his character, he wrote his first comedy, entitled the *Funeral*, or *Grief à-la-mode*, which was acted in 1701, with considerable success. Through the recommendation of Addison, whom he had known at Charterhouse, he was appointed, in the beginning of the reign of Anne, to the post of writer of the *London Gazette*. His comedy of the *Tender Husband* (in which Addison had some hand) appeared in 1703, and his *Lying Lover* in 1704. In 1709 he began the periodical paper so celebrated under the title of the *Tatler*, which included a portion of the information of a common newspaper, but, in raciness of humour and vivacity and urbanity of tone, was not, perhaps, exceeded by the most celebrated of its successors. The majority of the papers in this periodical are by Steele, but a considerable number are wholly or partly by Addison, and one or two by other writers. As it sided with the existing ministry, and was extensively circulated, its projector was appointed one of the commissioners of the stamp duties. Early in 1711 the *Tatler* was succeeded by the still more celebrated *Spectator*, in which the assistance of Addison and other eminent writers was more regular than in its predecessor, although Steele, as before, had a large share of the burden. The *Spectator* terminating, Steele commenced, in March, 1713, the *Guardian*, which was followed in October of the same year by a political periodical called the *Englishman*. He also wrote about this time several other political pieces of temporary celebrity. By this time he had taken to active political life, having been returned to Parliament as member for Stockbridge in August, 1713. In March, 1714, he was expelled the house for an alleged libel in the last number of the *Englishman*, and in another paper called the *Crisis*. His expulsion being purely the result of ministerial resentment, he regained favour on the accession of George I., and received the appointments of surveyor of the royal stables, and governor of the king's comedians, and was knighted (1715). He had again entered the House of Commons as member for Boroughbridge. On the suppression of

the rebellion of 1715 he was appointed one of the commissioners for the forfeited estates in Scotland, when he busied himself in an abortive scheme for a union between the churches of England and Scotland. Devoid of all prudential attention to economy, he was uniformly embarrassed in his circumstances, although he married two wives successively with respectable fortunes. Always engaged in some scheme or other, few or none of which succeeded, he wasted his regular income in the anticipation of a greater, until absolute distress was the consequence. A scheme for bringing fish to market alive, in particular, involved him in much embarrassment, which was heightened by the loss of his theatrical patent, in consequence of his opposition to the peerage bill (1720). He appealed to the public, in a paper called the *Theatre*, which he had begun to publish at the beginning of 1720, a week or two before the event referred to. In the same year he honourably distinguished himself by his opposition to the famous South Sea scheme. He was restored, the following year, to his authority over Drury Lane Theatre, and soon after wrote his comedy of the *Conscious Lovers*, on a hint from Terence. This piece he dedicated to the king, who rewarded the author with £500. His pecuniary difficulties, however, increasing, he retired to Carmarthen, in Wales, where he died on Sept. 1, 1729. See the *Life by Aitken* (1889).

STEEL TOYS, the trade designation of such small articles as cork-screws, button-hooks, &c., when made of polished steel. They are chiefly manufactured at Birmingham and Sheffield.

STEELYARD, the name of the factory in London belonging to the Hanse merchants, who were hence known as the merchants of the Steelyard. How it got the name is not known. It was situated on the Thames, a little above London Bridge, between the river and Thames Street on the south and north, and Dowgate and Allhallows Lanes on the west and east. It was in the parish of Allhallows, in the church belonging to which several rows of seats were set apart for the merchants of the Steelyard, to whom the church, on being rebuilt after the fire, owed several stained-glass windows, a beautiful rood-screen of carved wood-work, and other ornaments. From a very early period, a period long before the establishment of the Hanseatic League, the German merchants in London enjoyed peculiar privileges. The first record of such privileges belongs to the reign of Ethelred II. (978-1016) and subsequent kings, who were often indebted to the German merchants for advances of money, renewed and increased these privileges, the chief of which was the right of importing commodities at much lower rates than the merchants of other nations. In course of time these privileges were monopolized by the Hanse merchants, and the factory of the Steelyard flourished and declined with the league. (See *HANSA*.) The members of the factory had a certain measure of self-government. Their affairs were managed by an alderman, with two assessors, and a committee of nine persons, all of whom were elected from their own number by themselves, all the 'masters' being entitled to vote. Their internal discipline was half monastic and half military. The members were not allowed to marry, and they were all obliged to keep warlike equipments for defence. Their factory was walled, and to this the Hanse merchants more than once owed their safety in popular risings, when Flemings and other foreigners were massacred. In return for the privileges granted them by the city of London, in addition to those which they held from the government, they were required to aid in defence of the city in case of need, and more particularly to keep Bishopsgate in a state of defence, and to watch

and derend it when circumstances required. After the decline of the Hansa the Steelyard remained in the possession of the free towns of Lübeck, Hamburg, and Bremen, the heirs of that powerful league, till 1853, when it was sold to some private speculators. See *Pauli's Bilder aus Alt-England*, ch. vi.

**STEELYARD**, of ROMAN STEELYARD. See **BALANCE**.

**STEEN**, JAN, a distinguished painter, was born at Leyden in the year 1626. He studied under Knupfer and Van Goyen, and married the daughter of the latter. Being imprudent and intemperate in his habits, he neglected all the advantages which lay in his way, until finally reduced to paint for a mere subsistence. He had a strong, manly style of execution, the result of native talent rather than of application, which, together with a fine sense of humour, conducted him to a high degree of professional excellence. Among his capital pictures are a Mountebank surrounded with Spectators, a Quaker's Funeral, and a Marriage Contract. His works did not obtain an extraordinary price during his life, but after his death rose greatly in value. His death took place in the beginning of 1679.

**STEENKERQUE**, a village of Belgium, in Hainaut, 14 miles N.N.E. of Mons. Here a bloody battle was fought between the allies, commanded by William III., king of England, and the French, under the Duke of Luxembourg, the 24th of July, 1692, in which the latter were victorious. Pop. 926.

**STEEPLE**, any tower-like structure attached to a church, whether a tower proper or spire or a combination of tower and spire or tower and lantern.

**STEEPLE-CHASE**, a species of horse-racing in which the horses are ridden usually for about 2 miles over ground covered with such obstacles as hedges, streams, ditches, &c. Such races were originally intended only for hunters, the breed of which it was hoped to improve in this way, and they got their name from the fact that any conspicuous object, such as a church steeple, was chosen as a goal, towards which those taking part in the race were allowed to take any course they chose, the race being won by the one who touched the goal first. This mode of racing soon after its introduction became very popular, and people began to crowd together to catch a sight of a race conducted in this fashion wherever it was announced to take place, but as it was difficult to see the race satisfactorily without following it on horseback, the mode of conducting it was modified for the convenience of spectators. A circular course was adopted instead of freedom being allowed to the competitors to follow their own course. Another change was afterwards made. The horses, instead of being equally weighted as they were at first, were handicapped, that is, they were weighted according to their merits or supposed merits. This was first done at Newport-Pagnell in 1841, and the practice was adopted at the Grand National Steeple-chase at Liverpool in 1843. The consequences of its introduction were at first very injurious to the interests of steeple-chasing, as it favoured trickery on the part of jockeys, who often endeavoured to make their horses appear worse than they were in order to secure a more favourable handicap. This has, however, been in some measure checked since the promulgation of the Grand National Steeple-chase Rules. As steeple-chases are now run, great fencing powers are not required in a horse, so that they are more commonly won by fleet racing horses with good powers of endurance than by those which have in a peculiar degree the qualities of a hunter.

**STEERAGE**, in a man-of-war, an apartment before the great cabin, from which it is separated by a partition or bulkhead. It serves only as a hall or ante-

chamber to the great or captain's cabin. In the old three-deckers the name was sometimes given to the admiral's cabin on the middle deck. In merchant ships the name is applied to the part of the ship allotted to the inferior officers and crew, and in passenger ships to that assigned to the cheapest class of passengers.—*Steerage* is also used to express the effort of the helm.—*Steerage-way* implies a sufficient degree of motion communicated to a ship for her to become susceptible of the effects of the helm in governing her course.

**STEERING**. See **HELM**.

**STEIERMARK**, or **STYERMARK**. See **STYRIA**.

**STEIN**, HEINRICH FRIEDRICH KARL, FRIEHER VON, a distinguished German statesman, was born at Nassau on the 26th of October, 1757. Between 1773 and 1777 he studied at Göttingen with the view of qualifying himself for promotion in the imperial chamber (*Reichskammergericht*), but he afterwards changed his intention and entered the Prussian service. In February, 1780, he was appointed to the mining department of the Prussian government, and in 1784 had risen to be the head of the department of Westphalian mines. When Frederick the Great, for the maintenance of the constitution of the empire, formed the Fürstenbund, it was Stein who, in 1785, persuaded the Elector of Mainz to give in his adhesion to the league. After managing this affair he went to England, where he made a lengthened stay with the view of increasing his technological knowledge. In 1787 he returned to Westphalia, and gradually rose in office until, in 1797, he was appointed president of the Westphalian chambers. After rendering important service in this public capacity by the formation of new roads and other improvements, he was in 1804 appointed head of the Prussian ministry of excise, customs, and commerce. Here his decided and occasionally harsh measures involved him in many disputes, and after the unfortunate years of 1806 and 1807 he fell into disgrace, and lived in retirement on his property. But his singleness of purpose could not long be dispensed with at the Prussian court. He was accordingly recalled (July, 1807), and began a course of activity, introducing important improvements, the main features of which still exist. While Scharnhorst was engaged in creating a new military force, Stein confined himself chiefly to matters of internal administration. During the short period of this second ministry he abolished serfdom, established the freedom of landed property, reformed the administration, and passed a series of thoroughgoing measures by which the state was carried over the terrible financial crisis of that period. His great object was to create a peasant and middle class, and to prepare the way for the conversion of an absolute monarchy into a representative government. In all his measures he never lost sight of the great object of throwing off the yoke of Napoleon and regaining the independence of his country. A letter written by him at this time, explanatory of his views, and giving free utterance to his hatred of the oppressor, having fallen into the hands of the French, he saw it necessary to resign in 1808. Indeed, Napoleon insisted on his dismissal, and by a decree, dated Madrid, in which he was spoken of as 'le nommé Stein,' he was placed under the ban. He received warning barely in time to escape arrest, and went first to Austria and afterwards, in 1812, when the Emperor Alexander had broken with Napoleon, to Russia, where he gave great assistance in making the preparations necessary to meet the common foe. The great aim of his exertions he saw happily crowned with success when the French were driven out of Germany. After the peace he retired into private life and devoted much of his time to literature and

science. In 1819 he led to the foundation of the society for the investigation of the early history of Germany, and it was in a great degree due to his encouragement that the great work published under the title of *Monumenta Germaniæ Historica* saw the light. The last years of his life were spent in Westphalia, where his career had commenced. He died on June 29, 1831. See Seeley's *Life* (1878).

STEINBOCK, or STEINBOK. See IBEX.

STELVIO, PASS OF THE, a military road leading over the Rætian Alps between the Tyrol and Lombardy, constructed by the Austrian government and completed in 1824. It is the highest pass in Europe practicable for carriages, being 9174 feet above the sea, and is a very remarkable specimen of human industry and skill. Its terraces cut in the solid rock, and those built of masonry strong enough to resist the fall of avalanches, its bridges and causeways, form its most remarkable features. It is seldom passable except from June to October.

STEM, a strong upright piece of timber, into which the two sides of a ship are united at the fore end; the lower end of it is scarfed to the keel, and the bowsprit rests upon its upper end; the ends of the planks of the sides and bottom are let into a groove or channel cut in the middle of its surface from top to bottom. It is backed up by a similar timber called the stemson. In iron vessels the stem is a piece of iron. The stem is usually marked with a scale of feet answering to a perpendicular from the keel, to ascertain the draught of water.

STEM, in botany. See BOTANY.

STENCILLING, a mode of decorating or marking with paint or ink, which may be adopted by those who are unskilled in the use of the brush. The design or mark is cut out in a sheet of pasteboard or a thin plate of metal called a *stencil*, which is applied to whatever is to be marked. The colouring matter is then laid freely over the stencil by means of a brush, and after the stencil is removed the design remains marked out on those parts of the surface which the colouring matter has reached through the spaces left in the stencil.

STENDAL, a town in Prussia, in the province of Saxony, on the Uchte, 35 miles N.N.E. of Magdeburg, formerly capital of the Altmark, a part of the old electorate of Brandenburg. It was once strongly fortified, and has a fine cathedral of the fifteenth century, a lyceum, an orphanage, and manufactures of woollens and stoves. Tanning is also carried on to a considerable extent. Winckelmann, the art critic, was born, and a statue has been erected to him in the town. Pop. (1885), 16,180; (1895), 20,666.

STENNIS, an inlet on the south-west side of the mainland of Orkney, having only a very narrow communication with the sea, and separated from the fresh-water loch of Harray by a narrow tongue of land running from north-west to south-east, and completed at the south-eastern extremity by a causeway of stones called the Bridge of Brogar, over which the tidal wave from the Loch of Stennis sometimes washes. The Loch of Stennis owes its celebrity to the fact that on its margin stand the remains of two remarkable groups of standing stones, the one called the Ring of Brogar, on the promontory just described, and the other called the Standing Stones of Stennis, on the south-east side of the loch, nearly opposite that promontory. Of these two groups the Ring of Brogar is the larger. When complete it appears to have consisted of sixty stones arranged in a circle of 340 feet in diameter, surrounded by a trench with an average depth of 6 feet; but only about a fifth of these are still standing entire, some others lying prostrate, and others having their position marked by their broken stumps. Of those still

standing the height varies from 5½ to 13½ feet, and the average breadth is 5 feet, the average thickness being 1 foot. The smaller circle does not appear to have consisted of more than twelve stones, but the average height of these was double that of those forming the Ring of Brogar. Only three of the stones of this circle are still to be seen, two standing and one prostrate. 'The neighbourhood of Stennis,' Daniel Wilson observes in his *Prehistoric Annals of Scotland*, 'seems to have been consecrated ground to the ancient Orcadians. Within no great distance there are two circles of standing stones, two others, all the remaining stones of which are prostrate, and four single standing stones, besides about twenty sepulchral mounds and earthworks of various forms and dimensions.' Of the single standing stones referred to one is the celebrated perforated stone of Odin (see STANDING STONES), and another a stone 17 feet in height, called the Watch Stone, standing at the south-eastern end of the Bridge of Brogar, and by some surmised to have been at one time part of an avenue connecting the Ring of Brogar with the circle of Stennis.

STENOGRAPHY. See SHORTHAND.

STENTOR, a well-known genus of Infusorial animalcules (see PROTOZOA), so named from the trumpet-like shape of the body. These forms are of tolerable size for Infusoria, their average size being about .04 of an inch—this being perhaps the largest dimensions of any Infusorian. Stentor is usually found adhering to the stems and leaves of aquatic plants. It can detach itself at will, and swims about by means of the abundant vibratile filaments or cilia with which its body is provided. True muscular fibres are said to be developed within the protoplasmic layers of Stentor's body—the presence of these fibres indicating an advance in development over the simpler structure of the bodies of its neighbour animalcules. A distinct mouth, as well as a permanent anal opening, exist in this genus of Infusoria, and the 'contractile vesicles' of the body are of large size. The *nucleus*, or central particle of the body concerned in reproduction, is of elongated band-like shape, and consists of an external membrane filled with granular contents. *Stentor Müllerii* and *S. polymorphus* are two species of these animalcules familiar to every microscopist.

STEPHEN, the name of nine popes, or of ten with the inclusion of one who died before consecration, and who is therefore usually omitted from the lists of popes.—STEPHEN I. (253–257) contended with Cyprian of Carthage about the validity of the baptism of heretics, maintaining against the latter that heretics on being again received into the bosom of the orthodox church must be rebaptized, contrary to the custom that then prevailed in Africa. On account of the persistent adherence of the African Church to its own practice Stephen cut it off from the body of the Catholic Church, into which it was not re-admitted till after his death. He is worshipped as a saint among the Roman Catholics, the 2d of August being the day sacred to him.—STEPHEN, sometimes called Stephen II., the pope above referred to who was elected in March, 752, but died four days after his election.—STEPHEN II. (752–757), called the Frankish king Pepin le Bref to his aid against the Lombards, who had conquered the Exarchate of Ravenna. Pepin defeated the Lombards, and as Roman patrician gave the exarchate to the pope, thus laying the foundation of the temporal dominions of the papacy, in return for which the pope crowned and anointed Pepin a second time.—STEPHEN III. (768–772), in a synod held at Rome in 769, sanctioned anew the worship of images, relics, and saints, as well as of the Virgin, in opposition to a decision come to by a synod

held at Constantinople.—STEPHEN IV. (816–817).—STEPHEN V. (885–891) came into collision with the Emperor Charles the Fat, on account of his having been consecrated before his election had received the confirmation of the emperor. In this contest the pope was victorious. In the contention for the crown of Italy between Guido of Spoleto and Berengarius of Friuli, this pope supported and crowned the former.—STEPHEN VI. (896–897) was involved in the party contests of the day, and stood completely under the influence of the leading Romans and Tuscans on the side of Guido. He has become notorious on account of the indignities he practised on the dead body of Pope Formosus, who had belonged to the opposite party. He caused the body to be exhumed and condemned to lay burial. He himself was taken prisoner by his opponents and strangled in prison.—STEPHEN VII. (929–931).—STEPHEN VIII. (939–943), a relation of the Emperor Otto I., otherwise of no importance.—STEPHEN IX. (1057–1058), a brother of Duke Godfrey of Lorraine. In his reign the separation took place between the Roman and Greek Churches. His reign is also noteworthy on account of the commencement of a series of internal reforms in the church which were probably due to the influence of Hildebrand, afterwards Gregory VII. When Stephen found his death approaching he made the Roman clergy and people swear that in case of the holy see becoming vacant the election of a successor to him should not be proceeded with until Hildebrand, who was then in Germany, had returned from his mission. His object no doubt was that Hildebrand's influence might be employed to secure the election of another pope who would be disposed to carry on the reforms begun during his own tenure of the Papal chair. The dates in this list of popes of the name of Stephen are those of the Roman Notizie.

STEPHEN, King of England, son of Stephen, Count of Blois, by Adela, a daughter of William the Conqueror, was born, according to some accounts, in 1104 or 1105, according to the Annals of England, about 1096. He was invited, when young, into England by his uncle Henry I., who gave him the earldom of Mortaigne, in Normandy, and large estates in England. He likewise procured for him in marriage the heiress of Eustace, Count of Boulogne. For these favours Stephen professed the most grateful attachment to the king, and was most zealous in taking the oath for securing the succession to Henry's daughter, the Empress Matilda or Maud. No sooner, however, did that monarch's death take place than he hastened from France to England, and laid claim to the crown for himself (Dec. 1135). (See HENRY I.) He was already well known and well liked in England, where he had resided for many years, and on his arrival in London to claim the crown he was at once received as king both by nobles and citizens. The concurrence of the clergy was obtained by Stephen's brother, the Bishop of Winchester. David, king of Scotland and uncle of Matilda, marched an army into England to support the claims of his niece, as he had sworn to Henry to do, but Stephen advanced to meet him with a strong force, and David found it advisable to conclude a truce. Nevertheless, Stephen's seat on the throne was very insecure. Many powerful nobles were secretly disaffected to his government, and Stephen, while chiefly occupied with establishing his claims, was utterly powerless to preserve order in his dominions. In 1138 David of Scotland once more invaded England, but in the battle of the Standard was entirely defeated by the northern barons (Aug. 22). In September of the following year (1139) the Empress Matilda landed in England with her half-brother, the Earl of Gloucester, and a civil war ensued, which

proved one of the most calamitous in the English annals. Stephen performed his part with vigour and courage, but, being taken prisoner in 1141, his party was broken up and Matilda was acknowledged queen. The haughty conduct of the new sovereign excited an insurrection against her government; and, being shut up in Winchester Castle, she escaped with difficulty, while the Earl of Gloucester was taken prisoner. Stephen was exchanged for the earl, and the war was renewed. Matilda was induced, by the death of the earl, to retire to Normandy (1145). A few years later the contest was resumed by her son Henry, who in 1149 made an inroad on the north of England from Scotland, but meeting with no success soon returned to Normandy. In 1152 he again invaded England, and was joined by the barons of his mother's party. The war was still going on in 1153, when Stephen's eldest son Eustace died, whereupon a treaty was concluded by which it was agreed that Stephen should reign during his life, that Henry should succeed him, leaving to William, the second son of Stephen, his father's patrimonial estates. On the death of the king the following year (1154) Henry quietly ascended the throne. (See HENRY II.) Had Stephen succeeded to the throne without opposition he possessed talents which would have enabled him to fill it with honour. His resistance to the encroachments of the clergy and the see of Rome were spirited and creditable, and he was active and able both in the cabinet and the field.

STEPHEN, St. Besides the first martyr of the Christian church, who was stoned to death (Acts vi. 9–15, and vii. 53–60), there are two celebrated saints of this name—Stephen I., a pope of the third century (see the article on the popes of this name), and Stephen I., king of Hungary (997–1038), who introduced the Christian religion into his dominions. The churches both of the East and West celebrate the memory of Stephen, the first martyr. The day dedicated to him by the Roman Catholic Church is the 26th of December, but there is another festival in his honour held on the 3d of August to commemorate the discovery of his reputed relics in 415.

STEPHEN BATHORI. See BATHORI.

STEPHENS, or STEPHANUS (the English and Latin forms of Estienne), the name of two distinguished scholars and printers.—ROBERT, the son of Henry Stephens, also a printer, was born in 1503, at Paris. He devoted himself to learned studies, and acquired a profound knowledge of Latin, Greek, and Hebrew, as the works edited by him in those languages show. After his father's death he was for several years connected with Simon de Collines, and superintended an edition of the New Testament, which was more correct and of a more convenient size and shape than any which had yet appeared. The rapid sale of this edition disturbed the doctors of the Sorbonne, who only wished for a pretence to forbid the dissemination of a book from which the adherents of the new (Lutheran) doctrines which Stephens embraced, drew all their arguments. About 1528 Stephens erected a press in his own name, from which proceeded a series of the most valuable works. Most of his editions of the Greek and Roman classics were enriched with notes and valuable preliminary treatises. He endeavoured to attain the greatest possible correctness, and for this purpose hung up his proof-sheets publicly, and offered a reward for the discovery of errors. In 1531 he published the first edition of his excellent *Thesaurus Lingue Latine*, which he improved in every successive impression. At first he printed with the types of his father and Simon de Collines; but he afterwards had a handsomer type cast, with which he printed the elegant Latin Bible of 1532. The

publication of this Bible drew upon him new persecutions, which, however, were averted by the protection of King Francis I., and by his promising to print nothing more without the consent of the Sorbonne. In 1539 he was appointed printer of Latin and Hebrew to the king. At his request Francis I. caused the beautiful types to be cast which are still in possession of the national press at Paris. The new attacks which he suffered, in consequence of his Bible of 1545, were rendered harmless for a time by the favour of the king; but after his death (1547) they were renewed with increased violence, and Stephens was at length forced to quit France. In 1552 he went to Geneva, where, in connection with his brother-in-law, he printed the New Testament in French, and established a new press of his own, from which several valuable works were issued. He died in 1559. His Hebrew Bibles (four vols. 4to, and eight vols. 16mo); the Latin Bible (folio, 1538-40); the New Testament (folio, 1550), which was formerly regarded as the most beautiful Greek book ever printed; his *Historiæ Ecclesiasticæ Scriptores*; Eusebii *Preparatio et Demonstratio Evangelica*; his *Dionysius of Halicarnassus*; *Dio Cassius* (first complete edition); and his *Terence*, *Cicero*, *Plautus*, &c., are highly esteemed.

Equally celebrated is HENRY, the son of Robert Stephens, born at Paris in 1528. Like his father, he early showed a taste for classical studies, for which he had great aptitude. His rapid progress in the Latin language is manifested by his annotations on Horace, published at the age of twenty years. He likewise studied the mathematical sciences with zeal. In 1547 he went to Italy, to avail himself of the treasures contained in the libraries at Florence, Rome, Naples, and Venice, and brought away several valuable copies of the classics. He also visited England and the Netherlands, and returned to Paris in 1552, just as his father was on the point of setting out for Geneva. He perhaps accompanied him thither; but in 1554 he was in Paris again, where he printed an edition of the so-called *Odes of Anacreon*. Within a year or two after he again set out on a visit to Italy, to collate the manuscripts of Xenophon and Diogenes Laërtius. On occasion of this visit he also discovered some fragments of *Diodorus Siculus*. In the beginning of 1557 he commenced a long series of important publications, on the preparation of which he bestowed a great deal of labour and expense. His expenditure indeed considerably outran his own resources, and he was largely indebted for pecuniary aid to his friend Ulrich Fugger, out of gratitude to whom he called himself, till the death of his patron, Fugger's printer. The publications of Henry Stephens bear the name of no places, and authorities differ as to where his press was situated, whether at Geneva or Paris, but it appears probable that all his earlier works at least first appeared at the former city. In consequence of his attachment to Protestantism his peace was often disturbed, and his labours interrupted. In 1566 he republished Valla's Latin translation of Herodotus, with a preface, in which he defended the father of history from the reproach of credulity. Robert Stephens had already begun to collect materials for a Greek dictionary; Henry pursued the arduous work, and in 1572 produced his long unrivalled *Thesaurus of the Greek Language*, which is a treasure of learning and criticism, and would alone suffice to secure its author permanent fame. An excellent edition of the *Thesaurus* was published in London (1816-26), with the additions of several philologists; and another, with the notes and additions of Hase and Dindorf, at Paris, in 1881, and following years. The high price of this work, and the abridg-

ment published by Scapula soon after its appearance, made the sale extremely slow; and the author became greatly embarrassed in circumstances. He then went to Germany, either for the purpose of recreation or to seek new means of support. About 1578, being annoyed by the persecutions of the authorities of Geneva (where there appears to be no doubt that he was then resident), Stephens repaired to Paris, where he was well received by Henry III., who granted him, on account of his work *De la Précellence du Langage François*, a reward of 3000 livres, and a pension of 800 livres, to enable him to continue his examination of ancient manuscripts, and treated him with great distinction; but this money was probably never paid him. At any rate, Stephens continued in pecuniary difficulties, and finally retired from court, in order to occupy himself more advantageously, and lived at Orleans, Paris, Frankfurt, Geneva, and Lyons. On a journey to the latter place he fell sick, and died in the hospital, in 1598, apparently deranged. Such was the end of one of the most learned and indefatigable scholars, who is pre-eminent for the services which he rendered to the cause of ancient literature. His editions of the classics have served as the basis of the text of almost all subsequent ones; and the charge that he tampered with the text of authors arbitrarily is without foundation. He translated many Greek authors into Latin, and produced numerous other valuable works.

STEPHENSON, GEORGE, was the son of a fireman at Wylam Colliery, near Newcastle, and born there on the 9th of June, 1781. Owing to the straitened circumstances of his father, who had to bring up a family of six children on 12s. a week, George remained without education up till the eighteenth year of his age. His first employment was that of a herd-boy at 2d. a day, then a hoer of turnips at 4d., and a clearer of coal from stones and dross, and at fourteen he became an assistant to his father, who had by this time removed from Wylam to Dewley Burn, in the same county. Of an active and inquiring spirit, he set himself assiduously to acquire a knowledge of, and keep in proper working order, the engine which it was his business to tend. At the age of seventeen he was promoted to be a 'plugman,' and at twenty a brakesman, and about this time also he attended an evening school, and acquired a knowledge of reading, writing, and arithmetic. In 1802 he married, and took up his abode at Willington; but in 1804, after removing to Killingworth, 7 miles north of Newcastle, his wife, who had born him a son, died, greatly to his affliction. He accepted the superintendence of an engine at Montrose, but after remaining there a year, and saving nearly £30, returned home, where he found his father reduced to blindness by an accidental discharge of steam. Both his parents were now settled by him in a small cottage, and entirely supported by him to the end of their days. He was re-engaged in his old situation at Killingworth, but being shortly afterwards drawn for the militia he had to sacrifice the greater part of his savings to obtain a substitute. Driven almost to despair he seriously contemplated emigrating to America, but could not raise sufficient funds. During his leisure hours in the evenings after work he employed himself in mending clocks and watches, making shoes, and cutting out suits of clothes, all of which crafts his mechanical genius had enabled him to acquire, and his handiwork in them was celebrated over the country. Various important tasks in connection with engines and mining operations were also successfully accomplished by him, and in 1812 he was appointed engineer at Killingworth Colliery, with a salary of £100 a year. The application of steam to the propelling of locomotives had

for some time engaged the attention of scientific men, and various attempts had been made to effect this object, but the endeavours hitherto had almost all proved abortive. Stephenson eagerly devoted himself to the working out of the idea, and having established an extended reputation for soundness of judgment and engineering skill he was supplied by Lord Ravensworth with the means of constructing a locomotive engine, which was placed in July, 1814, on the colliery tramway, and drew eight loaded waggons at the rate of 4 miles an hour. Though thus partially successful, Stephenson saw that more was needed to make this mode of conveyance advantageous, and he accordingly invented the 'steam blast,' which enabled him to double his rate of speed, and in 1815 he took out a patent for, and constructed an engine, which up to the present day (under certain modifications and improvements) has, like Watt's steam-engine, continued as a model in the construction of locomotives. In this same year he devised a safety-lamp, the *Geordie*, for miners, which was produced prior to and altogether independent of the better known invention of Sir Humphry Davy, and is still employed in preference to his in some parts of Northumberland. The following year he took out a patent for an improved form of rail and chair, having become sensible that considerable improvements were necessary in the construction of the roadway as well as of the engine by which it was to be traversed. About the same period he married for the second time. In 1819 he was employed to construct a railway for the proprietors of the Hetton Colliery, and in 1822 the Stockton and Darlington line for Mr. Pease, who appointed him resident engineer, with an annual salary of £300, and on this event taking place he removed to Darlington. The line was opened in September, 1825, the engine being driven by Stephenson himself, and drawing thirty-eight carriages, comprehending a weight of about 90 tons, at a rate of from 8 to 10 miles an hour. This was the first steam railway in Britain on which passengers were conveyed as well as goods. At this period a copartnership was formed between Mr. Pease and Mr. Stephenson for the establishment of a locomotive manufactory at Newcastle, which was long the only work of the kind in the kingdom, and rapidly increased in extent and importance.

The scheme of constructing a railway between Liverpool and Manchester had been set on foot in 1824, but the opposition to it, both in and out of Parliament, was so strong that it had to be temporarily abandoned. The bill was passed, however, on a second application, and the work commenced in June, 1826. After overcoming many difficulties, one of the greatest being the carrying of the line over Chatmoos, the railway was opened on Sept. 15, 1830, and the results of the undertaking were most triumphant for Mr. Stephenson, and proved the commencement of a system of railroad transit which has since overspread like a net-work the face of the country, and indeed effected a complete social revolution. For ten years subsequent to this there was scarcely a line of railway opened in Britain with the construction of which Stephenson was not concerned. In 1840 he resigned most of his appointments, and settled at Tapton, in Derbyshire, where he took in hand the working of the Clay Cross Collieries, leaving the extension of the railway system to be carried out by his son Robert. He still, however, remained connected either as engineer or otherwise with several lines, made professional journeys to Spain and Belgium, and was created a knight of the latter country by King Leopold. In his latter years he led much of the life of a country gentleman, looking over his collieries and lime-works, and amusing himself with horticultural

operations and the keeping of birds and animals, which had been one of the favourite pursuits of his youth. He also took a considerable interest in mechanics' institutes, and was the founder and president of the Institution of Mechanical Engineers at Birmingham. An intermittent fever carried him off on 12th August, 1848. George Stephenson may be regarded as an embodiment of the sturdy and energetic spirit which has raised the British nation to its high position among the other countries of the world, and enabled it to effect such triumphs in enterprise of every kind. A real hero, brave, indefatigable, and upright, he afforded as noble a specimen as could be desired of the true 'nature's gentleman,' and has left an example behind him to our British youth of how much may be accomplished by industry, perseverance, and rectitude.

STEPHENSON, ROBERT, son of the foregoing, was born at Willington, near Newcastle, on the 16th December, 1802. His father, who deeply felt his own want of education, resolved to strain every nerve to secure the advantages of it to his son, and accordingly sent him first to a school at Long Benton, and afterwards to one in Newcastle, one of the best in the district. On leaving school at the age of fifteen he was apprenticed at Killingworth Colliery, and continued there for three years, acquiring in that time a thorough knowledge of mining operations. In 1820 his father sent him to Edinburgh University, from which he returned the following year, bringing with him a prize for mathematics. The elder Stephenson having shortly after this engaged in the locomotive manufactory at Newcastle in conjunction with Mr. Pease, Robert became his apprentice in 1822, but his health giving way after two years, he accepted an engagement to examine the South American mines, and through the beneficial effects of the voyage and change of climate succeeded in re-establishing it, returning to England in 1827 by way of the United States and Canada. Not long after his return he assisted his father and Henry Booth in the construction of the locomotive (the 'Rocket') which gained the prize of £500 offered by the directors of the Liverpool and Manchester Railway for the best railway engine. The next great work on which he was engaged was the construction of the London and Birmingham Railway, of which he was appointed engineer. The first sod of the line was cut at Chalk Farm in June, 1834, and the railway was opened to the public in September, 1838. During the course of this work he walked the whole distance between London and Birmingham more than twenty times. Like his father he was concerned more or less closely with the projection and construction of almost all the English railways, and this was more especially the case after the former's retirement from public life. Much of his attention was also given to the superintendence of the manufactory at Newcastle, and he made frequent professional journeys abroad, laying out lines of railway in Switzerland, Germany, and other parts of the Continent, and likewise in Canada, Egypt, and India. One of the most brilliant proofs of his engineering skill is displayed in the system of railway bridges and viaducts constructed under his directions. Among these may be mentioned more especially the high-level bridge at Newcastle, the Victoria Bridge at Berwick, the tubular bridges, of which he was the inventor, as exemplified in those over the Conway and the Nile, and the still more wondrous erections of the Britannia Bridge over the Menai Straits, and the Victoria Bridge over the St. Lawrence. He took a considerable interest in public affairs, and during the last twelve years of his life represented the borough of Whitley in Parliament. The sterling qualities of George Stephenson were fully inherited by his son, and no man stood in

higher estimation with his fellow-men, whether as an engineer, a master, or a friend. Large sums were annually expended by him in benevolent purposes, and he was especially generous in assisting the children of old friends who had shown him kindness in early life. He died at his residence in Gloucester Square, Hyde Park, London, on 12th October, 1859, and was interred in Westminster Abbey, beside Telford. He never was married. See for the subject of this and the preceding article Smiles's *Lives of the Engineers*, vol. iii. (London, 1862).

**STEPPE**, a Tartar term now employed by geographers to denote those extensive flats which, beginning at the Dnieper, extend along the south-east of Russia, round the Caspian and Aral Seas, between the Ural and Altai Mountains, and occupy a considerable portion of Siberia. These steppes present wide, treeless, monotonous tracts, which are covered with rough grass and shrubs during the short spring season, but soon become arid deserts owing to the drought of summer, and in winter are wastes of snow. Though they are all open, flat, and treeless, they differ considerably in aspect according to the nature of the soil of which they are composed; some tracts consisting of deep, black earth, clothed with shrubs and grasses; others of hard, sandy clay, and sterile; and others again of sand or rocky shingle, and only here and there dotted with vegetation. This applies, however, only to the spring and early summer; for during the summer droughts all are alike desert save round the springs and streamlets, and during winter, which comes on in October, the whole is one exposed and inhospitable snow-waste. The Siberian plain, as might be expected from its extent, is of a more varied character, consisting of low-lying tundras, or black, swampy peat mosses, of broad undulating steppes and partially wooded uplands; but the tundras and wooded lands are scarcely included in the steppes proper. From June till the middle of August the tundras are thawed to a small depth, the steppes are scantily covered with grass and mosses, the banks of the great rivers are green with the birch and pine, and immense herds of horses and cattle give animation to the scene. In winter fearful storms rage, and the dry snow is driven by the gale with a violence which neither man nor animals can resist.

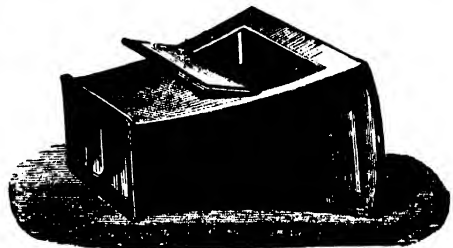
**STERCULIACEÆ**, a natural order of hypogynous Exogens, nearly allied to Malvaceæ, from which they differ in possessing two-celled anthers. They consist of tropical herbs, shrubs, or trees, having alternate entire lobed or digitately compound leaves, furnished with stipules, and produce axillary or rarely terminal flowers, which are often large and handsome. The order has been divided into the following sections: 1. Bombaceæ, with hermaphrodite flowers and palmate or digitate leaves; found more abundantly in America than elsewhere; 2. Helicterææ, with hermaphrodite flowers and simple leaves; apparently unknown in Africa; 3. Sterculiææ, with unisexual flowers, and either simple or palmate leaves, met with chiefly in India and Africa. There are thirty-four genera, including about 130 species. The plants are mucilaginous and demulcent; many are used for food, others supply a material like cotton. The food-producing kinds include *Adansonia digitata*, the Baobab-tree of Senegal (see *BAOBAB*); *Durio sibiricus*, which furnishes the fruit called durian in the Indian Archipelago; this fruit is much prized, though it has a fetid odour, hence the name Civet Durian; the cola, mentioned by African travellers as being used to sweeten half putrid water, is the seed of *Sterculia acuminata*. (See *COLA*.) The silky hairs surrounding the seeds of *Bombax ceiba*, the silk cotton-tree, are used for stuffing cushions and chairs,

and for other domestic uses, but cannot be made into cloth, as no adhesion exists between the hairs.

**STERE.** See **DIOPTAL SYSTEM**.

**STEREOGRAPHIC PROJECTION.** See **MAP**.

**STEREOSCOPE**, an optical instrument in which two photographic pictures of the same set of objects give one representation of the objects. Suppose an inch cube is placed with one of its faces so that a vertical plane bisecting that face at right angles will also bisect the straight line joining the two eyes of a spectator whose face is a short distance from the face of the cube. If the cube be looked at with the right eye only (suppose) three faces are seen, namely, the top face, the face in front, and the right-hand face; looked at with the left eye the faces seen are the top face, the front face, and the left-hand face; looked at with both eyes the separate impressions of the eyes are combined, and this combination is effected in the stereoscope by combining two pictures, one taken from the point of view of the right eye, the other from the point of view of the left eye. What one eye can see from any position may be accurately represented by a carefully executed perspective picture, but the effect on the two eyes can only be represented by means of the stereoscope. Our impressions of the relative distances of objects and portions of objects arise from the effect on the two eyes. The objects of a group represented in the stereoscope stand out from one another in complete relief, and in proportion to the perfection of the photographs the representation is perfect. In executing photographs of distant objects for the stereoscope the pictures are better when the points of view are an exaggerated distance apart (in some cases as much as 10 feet), because this exaggeration enables the spectator to judge of the relative positions of distant objects when represented in the instrument, as if those objects were near. In the



accompanying figure we give an illustration of the most common form of stereoscope. The pictures are inserted by the slit seen at the right-hand portion of the figure, the flap above, having some tin-foil pasted to it so as to reflect light into the instrument on the pictures, is represented as raised, and a thin partition of wood may be seen which confines each eye to its own picture. The openings at the left are filled with glasses formed by dividing a double convex lens in two equal parts, and placing the pieces so that their thickest parts are the most distant asunder. Sir Charles Wheatstone invented the stereoscope.

**STEREOTYPE PRINTING** (Greek, *stereos*, firm, and *typos*, figure or form) is the name applied to a species of printing, which, within the present century, has come to be extensively practised. The ordinary method of printing has been fully described under the article **PRINTING**. Stereotype printing consists in casting, by means of a stucco or paper mould, a representation of the superficies of arranged types, which, being fitted to a block, may be used under the press exactly as types are used, and, being retained, may serve at any time to throw off an addi-

tional impression. About the year 1711 Van der Mey of Leyden invented a method of forming the types into solid blocks by soldering their lower ends together, and with these he printed several thousand Dutch Bibles. This method, though it saved the labour and expense of composing and correcting for subsequent editions of the same book, did not release the types for other uses. The merit of inventing the improved process by which the types are liberated seems properly to belong to William Ged, a goldsmith of Edinburgh, who is said to have attempted stereotyping in the year 1725. In July, 1729, Ged entered into a partnership with William Fenner, a London stationer, allowing Fenner half the profits of his invention in consideration of his advancing the necessary funds. Afterwards John James, an architect, was taken into the scheme for the same purpose, as was likewise Thomas James, a letter-founder, and James Ged, the inventor's son. In 1730 this company proposed to the University of Cambridge to print for it Bibles and Common Prayer Books by stereotype, and the lease was sealed to them April 23, 1731. In their attempt they sank a large sum of money, and finished only two prayer-books, so that it was forced to be relinquished, and the lease was given up in 1738. Ged imputed his want of success to the jealousy of the workmen in marring the plates, and the bad conduct of his partner Fenner. He returned to Edinburgh with blighted prospects; but still prosecuting his invention, published in 1744 a stereotype edition of Sallust, bearing the following imprint: 'Edinburgi, Gulielmus Ged, Aurifaber, Edinensis, non typis mobilibus, ut vulgo fieri solet, sed tabellis seu laminis fusiis, excudebat, MDCCXLIV.' (executed at Edinburgh by William Ged, Goldsmith of Edinburgh, not by movable types, as is usually the case, but by tablets of cast metal, 1744). Some of the original plates of this work are still extant in our museums, and complete copies of the book are in existence. Ged, like many other ingenious men, died in reduced circumstances, before the utility of his invention was appreciated, October 19, 1749. Two of his sons, William and James, settled in Jamaica as printers.

About thirty years after the death of Ged, Mr. Tilloch of Glasgow, without having at the time any knowledge of Ged's discovery, made a similar one of his own; and with the assistance and joint labour of Mr. Foulis, printer to the University of Glasgow, he greatly improved upon the invention, after many experiments and much labour. 'Though we had reason to fear,' says Mr. Tilloch, 'from what we afterwards found Ged had met with that our efforts would experience a similar opposition from prejudice and ignorance, we persevered in our object for a considerable time, and at last resolved to take out patents for England and Scotland, to secure for ourselves for the usual term the benefits of our invention; for the discovery was still as much our own as if nothing similar had been practised before.' The patents were accordingly obtained, but owing to circumstances of a private nature the business was for a time laid aside, and the concern was at length dropped entirely, after Mr. Tilloch's removal from Glasgow to London. Prior to this, however, a number of small volumes had been stereotyped and printed under the direction of Messrs. Tilloch and Foulis.

Firmin Didot, the celebrated French printer, sometime afterwards applied the stereotype art to logarithmic tables, and then to some of the Latin classics, as well as to a number of French publications. His original method of stereotyping differed much from that now in use. He took movable letters, differing from the common ones only by being somewhat

shorter and of a harder substance. These were set in the usual way; the proof sheets were then printed and corrected, till the whole copy was as free from errors as possible. Then every page set with these hard letters was pressed upon a plate of properly prepared metal. These plates served as matrices for whole pages; and the letters of the hard substance mentioned above might now be separated from each other, set anew, and used to form other matrix plates. A page which served for a matrix was pressed upon melted type-metal, which, hardening immediately, served for printing. In this manner was Callet's logarithmic tables printed in 1795.

To the patronage of Earl Stanhope the art of stereotyping is greatly indebted for its improvement and general adoption in this country. It is said that his lordship was instructed in the mystery by Mr. Tilloch, and afterwards had, at his estate of Chevening, the personal attendance of Mr. Foulis for several months. Mr. Wilson, a respectable printer in London, engaged with Earl Stanhope, some years after this, in prosecuting experiments towards the improvement of the art; and in January, 1804, Mr. Wilson laid before the University of Cambridge the result of their experiments in stereotyping, with offers to execute by stereotype the Cambridge Bibles, Testaments, and Prayer-books. Some difference, however, arose between the syndics of the university and Mr. Wilson, on which occasion the latter published his case in a stereotyped pamphlet, entitled, *Arbitration between the University of Cambridge and Andrew Wilson*.

By degrees the benefits of stereotyping began to be understood, and it has now long been adopted in Europe and North America in the production of numerous works, particularly standard authors, for whom there is a continued demand, and works published in parts or numbers. In the case of a book in general use, such as the Bible, and also in cases where the publication takes place in numbers, and one number is in danger of being sold to a greater extent than another, stereotyping is of vast utility. It may indeed be pronounced absolutely necessary to the production of cheap books in large numbers, and therefore a most important auxiliary in the diffusion of knowledge by the printing-press. It saves the publisher from printing more copies at a time than may be required, or from the necessity of a new composition of types for every new demand. In some cases, too, by casting more plates than one, the same work may be printed in different parts of the world at the same time, without the cost of a different composition of types for each place, and so as to avoid the carriage of printed sheets from one quarter to another. The stereotyping of large daily newspapers, besides having the advantage of furnishing duplicate plates, is found to be of great economy by saving the types from wear in the press, and returning them to the cases as soon as a single cast is taken from the forms.

We shall now briefly describe the processes of stereotyping as at present generally practised, beginning with the stucco or gypsum process, which, until about the year 1856, was the universal method in this country. The first point in stereotyping is that of taking a mould from each page of movable types. The pages are not arranged as they would be combined in a sheet, and wedged up together in one iron frame or chase, but each page is put in a separate chase. It is essential that the face of the types should be perfectly clean and dry, and that no particle of dirt or other substance should attach to the bottom of the types, so as to prevent them being level upon the surface. The spaces, quadrats, and leads (see PRINTING) are of the same height as the

stem of the letters, the object being to diminish the number and depth of the cavities in the page, and thus lessen the chances of the mould breaking off and remaining in the form. The page is now placed upon the lower part of a moulding-frame. The upper part of the frame is somewhat larger than the page, and the margin of mould thus formed determines the thickness of the plates. The types having been previously rubbed over with an oily composition or plumbago, to prevent the mould from sticking to them, plaster of Paris is poured evenly over the whole surface. This substance, from a liquid state, soon becomes perfectly solid. Much nicety is required from the workman in forming the mould and in removing it from the type. If any part of the plaster adheres to the face of the type the mould is imperfect, and the operation must be gone over again. Having been removed and found perfect, it requires some dressing with a knife on its edges, and several notches are cut in the margin to allow the metal to enter the mould. It is now fit for baking. This process also requires much care. The oven in which the moulds are placed must be kept at a very regular temperature, for if it be too hot the moulds warp. The process of casting begins when the moulds have been baked sufficiently long to be perfectly dry and hard. At the bottom of the pot is a movable plate of cast-iron, called a floating-plate, and upon this plate the mould is placed with its face downwards. Upon the back of the mould rests the cover of the casting-box, which is held tightly down upon the mould by a screw. The apparatus for plunging the casting-box into the metal pit is attached to a crane, and is so constructed as to swing with a perfectly horizontal motion. The casting-pot with the mould, being suspended over the metal pot, is gradually forced down into the metal, and there kept steady by a lever and weight. The lid of the casting-box is cut off at the corners, and it is through these spaces that the metal enters the box, and insinuates itself into every hollow. After having remained immersed for about ten minutes it is steadily lifted out by the crane, and swung to a cooling trough, in which the under side of the box is exposed to water. Being completely cooled, the workman proceeds to remove the mould from the casting-box. The plaster-mould, the plate moulded, and the floating-plate are all solidly fixed together. The metal, by its specific gravity, has forced itself under the floating-plate, which it has driven tightly up against the ledges of the mould. The mould has in the same way been tightly driven up against the lid of the casting-box. The notches in the ledges of the mould have at the same time admitted the metal into the minutest impression from the face of the types. The caster or workman now breaks off the superfluous metal and the ledges of the mould with a wooden mallet. The mould is necessarily destroyed; and if another plate is required, another mould must be taken from the types. After the superfluous metal and the plaster are removed the stereotype plate comes out, and is then prepared for the press. Its proper thickness cannot be determined by the mould alone; and the back of the plate is therefore turned in a lathe, in which the plate revolves against a cutting tool, and a perfectly true surface is obtained by the superfluous parts being cut away in a series of concentric circles. Besides this, the very best casting cannot prevent occasional defects in the face of the plate, and it requires therefore to be minutely examined by workmen called *pickers*. It is the business of the picker to remove the small globules of metal which occasionally fill up or blot the letters; to insert a new letter, which he can do by soldering, if any one be broken, and

even to make an alteration of a word or a line if it should be found necessary.

There are certain disadvantages connected with this process which prevented it from being largely employed in newspaper work. Plates could not be produced and used for printing in a shorter time than six hours; as the stucco matrix is broken in being detached from the plate, fresh moulds have to be made when duplicates are required, and in course of a short time the more delicate parts of the type get worn off in cleaning them and oiling them for the stucco. These disadvantages have in a great measure been got rid of by the paper or *papier mâché* process. In the Times office, where this method is carried on in its greatest perfection, plates have been produced in seven minutes; the fount of type from which the moulds are originally taken, instead of wearing out every two years, may last more than thrice that time; and in cases where reprints are often required the moulds are light, inexpensive, and easily stored, and the metal plate may be melted down and recast after printing the first edition. The paper process may be briefly described as follows:—On the face of the type is laid a mould consisting of several sheets of tough thin tissue paper, gummed together and moistened, backed with a sheet of fine-grained brown paper. The types and paper are then placed in a press, where a roller passes under the form, pressing it up on the paper, and making an impression on it. The depressions made by the types rise on the outside of the paper, so that any part which has not been properly impressed is readily observed. Such spots are removed by driving the paper between the types by striking it with a hard brush. The interstices on the back of the matrix are filled up with a thin coating of stucco. The mould is then dried on a hot iron table, a blanket being laid over it to absorb the moisture, and screwed down moderately tight to prevent warping. In a few minutes the drying process is complete, and the mould is put into a shallow metal box, with its smooth side pressed firmly against the metal. The lid of the box is then put on, and molten type-metal is run in through a hole at the top. When the cast sets it is removed from the box, and is examined and picked, as in the stucco process, the elevations which occur in the wide spaces between the types being removed with a chisel. The paper-mould can be easily detached from the plate without damage, and may be used again should fresh plates be wanted.

STERLET. See STURGEON.

STERLING, an epithet of English money of account. The origin of the term is stated by Camden as follows:—"In the time of King Richard I. monie coined in the east part of Germanie began to be of especial request in England for the puritie thereof, and was called *Easterling* monie, as all the inhabitants of those parts were called *Easterlings*; and shortly after, some of that country, skillfull in mint matters and alliaies, were sent for into this realme to bring the coine to perfection, which since that time has been called of them *sterling* for *Easterling*."

STERLING, JOHN, a poet, essayist, and critic, was born at Kames Castle, in the Island of Bute, on 20th July, 1806. His father, Edward Sterling, who subsequently became noted as the editor of the Times newspaper, was residing as a gentleman-farmer at Kames Castle, which he had rented, having been educated for the bar, and afterwards served some time as an officer in the army. Of seven children which he had, five died in youth. In 1809 the family removed to Llanblethian in Glamorganshire, in 1814 to Paris, and from thence in the following

year to London. After having attended various schools the subject of the present memoir was sent to Glasgow University, from which, after a short period of study, he passed in 1824 to Trinity College, Cambridge. He had here for his tutor Julius Hare, afterwards rector of Hurstmonceaux, and for his fellow-students Frederick Maurice, Richard Trench, Monckton Milnes (afterwards Lord Houghton), and others, who afterwards attained so distinguished a position in the intellectual world. At the meeting of the Union Debating Club he became one of the chief speakers, but left the university in 1827 without taking his degree. The following year the Athenæum, then just started by James Silk Buckingham, was purchased by him, and conducted for some time by him and Mr. Maurice. It proved an unsuccessful speculation, and the proprietorship of the paper was transferred to other hands. Sterling continued to reside in London, the cynosure of a brilliant literary circle, and about 1828 made the acquaintance of Coleridge, whose conversation appears to have exercised great influence on his mind. In November, 1830, he married, and shortly afterwards with his wife made a voyage to the Island of St. Vincent in the West Indies, where some property had been bequeathed him by an uncle. He returned to England in 1832, and in the spring of the following year his novel of Arthur Coningsby was published, but attracted little attention. Not long after he met again his old tutor Julius Hare, and by intercourse with him was so confirmed in the sentiments which he had already imbibed from Coleridge, that he resolved to take holy orders. He was accordingly in 1834 ordained a deacon, and immediately afterwards became Mr. Hare's curate at Hurstmonceaux, Sussex. This office, however, was only retained by him for a few months, being resigned in February, 1835, on the plea of delicate health. Another change in his opinions seems about this time to have taken place, and he gradually diverged henceforth in his religious views from the doctrines of the Church of England. In 1835 he first became acquainted with Mr. Carlyle. His health continuing to decline, he went in the following year to the south of France, and afterwards to Madeira, from which he sent home some contributions to Blackwood's Magazine. In the spring of 1838 he returned to England, and from this period to his death at Ventnor, in the Isle of Wight, on 18th September, 1844, was occupied with various literary labours, and moving about to different localities in the vain search of renewed health, including a residence in the south of England and at Clifton, visits to Italy, and a second voyage to Madeira. He wrote for the Westminster Review (then conducted by John Stuart Mill), and published in 1839 Poems by John Sterling; in 1841 The Election, a poem in seven books; and Strafford, a tragedy, in 1843. A collection of his Essays and Tales, contributed to various periodicals, was made by Archdeacon Hare, and published with a memoir in 1843. Another biography of Sterling, depicting his life from a less ecclesiastical point of view, appeared from the pen of Mr. Carlyle in 1851.

STERN, the posterior part of a ship, or that part which is presented to the view of a spectator, placed on the continuation of the keel, behind.

STERNBERG, a town of Austria, in Moravia, on the railway from Vienna to Prague, 10 miles N.W. of Olmütz. It is well built, with an old castle, a church, and important manufactures of linen, cotton, hosiery, and liqueurs. It was nearly destroyed in 1789 by a waterspout which burst upon it. Pop. (1890), 15,332.

STERNE, LAURENCE, the author of *Tristram Shandy*, was the son of a lieutenant in the army,

and born at Clonmell, in Ireland, 24th November, 1713. He lived for part of his boyhood in Ireland, and afterwards being handed over to the care of a relative in Yorkshire, was put to school at Halifax in 1722, whence he removed to Cambridge, and studied for the church. He took his degree of Master of Arts in 1740, and, by the interest of Dr. Jaques Sterne, his uncle, a prebendary of Durham, he obtained the living of Sutton, and also a prebend of York. Subsequently, by the interest of his wife, whom he married in 1741, he obtained the living of Stillington, at which and at Sutton he performed the clerical duties for nearly twenty years. During this period he appears to have amused himself with books, painting, music, and shooting, but was little known beyond his vicinity, the only production of his pen being his humorous satire upon a greedy church dignitary of York, entitled the *History of a Watch Coat*. In 1759 appeared the two first volumes of his celebrated *Tristram Shandy*, which drew upon him praise and censure of every kind, and became so popular that a bookseller engaged for its continuance on very lucrative terms. Accordingly a third and fourth volume appeared in 1761, a fifth and sixth in 1762, a seventh and eighth in 1764, and a ninth, singly, in 1766. If, in the groundwork of this extraordinary production, a resemblance may be traced to the ridicule of pedantry and false philosophy in *Scriblerus*, the style and filling up are chiefly his own, although he borrowed entire passages from Burton's *Anatomy of Melancholy*, and the works of Rabelais, Bishop Hall, and others. In 1768 he produced his *Sentimental Journey* (in two vols. 12mo), which, by a number of pathetic incidents and vivid strokes of national and characteristic delineation, is rendered extremely entertaining, and acquired a more general reputation than even its predecessor. In 1760 appeared two volumes of *Sermons of Mr. Yorick*, to which he added two additional volumes in 1766, with his own name. He died of pulmonary consumption in March, 1768, leaving a widow and one daughter. The latter, who was married to a French gentleman, published a collection of her father's letters, in three volumes, 12mo, to which were prefixed memoirs of his life and family. Other letters of his were afterwards published. Of Sterne's genius, as of his character, conflicting opinions have been expressed by some of our best critics. According to Hazlitt his style is the most rapid, the most happy, the most idiomatic of any that is to be found. 'It is the pure essence of English conversational style; his works consist only of brilliant passages; his wit is poignant though artificial; and his characters, though the groundwork of some of them had been laid before, have yet invaluable original differences, and the spirit of the execution, the master-strokes constantly thrown into them, are not to be surpassed. There appears to have been in Sterne a vein of dry sarcastic humour, and of extreme tenderness of feeling, the latter carried sometimes to affectation, but at other times pure and without blemish.' According to Thackeray, one of the most unsparing of his critics, 'this man—who can make you laugh, who can make you cry too—never lets his reader alone; when you are quiet he thinks he must rouse you, and turns over head and heels, or sidles up, and whispers a nasty story. The man is a great jester, not a great humourist. He goes to work systematically and of cold blood, paints his face, puts on his ruff and motley clothes, and lays down his carpet and tumbles on it.' Few, we think, will coincide in this criticism of Thackeray's, to its full extent at least. To say that Sterne was a great jester is no doubt correct; he wrote to amuse people, and his jests and whimsicalities are intended for that purpose.

If his perpetual wish to be amusing sometimes makes his attempts a little forced, the reader, in whose behalf they are made, should try to treat his failures leniently. To deny that Sterne was a great humorist is to be blind to some of the truest and most delicate humour that English literature contains. To defend Sterne on the charge of indecency is a more difficult matter. As to his character, he has been called an irrevocable scoundrel, a disgrace to his sacred profession, a man who could snivel over a dead donkey and allow his mother to starve, a faithless husband, and what not. The charge of allowing his mother to starve seems to be without foundation; for the other charges there are more or less grounds. Sterne seems indeed to have been neither altogether a scamp nor altogether a hero. He was a man who had good stuff in him, had he only cared or known how to use it. But the incense of the great in London, at whose tables he was always eagerly welcome, spoiled his head, as their ragouts had done his stomach. He lived at a time, too, when the indiscretions of drinking, swearing, fox-hunting, fighting, duelling parsons were lightly tolerated. His head was overpowered by his impulsive heart; but they who aspire to teach, or even to amuse mankind, are not justified in allowing their feelings to run away with their judgment. See Percy Fitzgerald's *Life of Sterne* (new edition, 1898).

STERNHOLD, THOMAS, one of the versifiers of the first metrical version of the Psalms, long used in public worship in churches, but which was superseded by the version of Tate and Brady, published in 1698. He was a native of Hampshire or of Gloucestershire, and educated at Oxford, and became groom of the robes to Henry VIII., who left him a legacy of 100 marks. He held a similar office under Edward VI., in whose reign he died, in August, 1549. The principal coadjutor of Sternhold in his versification of the Psalter was John Hopkins; and the names of these persons have become a proverbial designation of bad poets. Sternhold also produced Certayne Chapters of the Proverbs of Solomon, drawn into Metre, which was published after his death.

STERN-POST, a long, straight piece of timber, erected on the extremity of the keel, to sustain the rudder and terminate the ship behind. It is usually marked, like the stem, with a scale of feet, from the keel upwards, in order to ascertain the draught of water shaft.

STERNUM, the name applied in human and comparative anatomy to the breast-bone of Vertebrate animals. A breast-bone is not developed in all Vertebrates. Thus, Fishes, Serpents, and in the view of most naturalists Tortoises and Turtles also, have no breast-bone. In man the sternum forms the front boundary of the thorax or chest in the middle line; and to it the first seven pairs of ribs (see RIB) are attached. It exists as a flattened bone of narrow conformation, and consists in the adult of three pieces. The upper portion is named the *manubrium*, from its faint resemblance to the handle of an ancient sword; the middle piece receives the name of the *gladiolus*; whilst the lowest portion (which is of cartilaginous nature in youth, but becomes more or less ossified in the adult) is named the *ensiform cartilage* or *xiphoid* appendage. The breast-bone naturally inclines obliquely from above downwards, and also in a forward direction. It exhibits a concave surface posteriorly, and gradually decreases in breadth from above downwards. Its average length in a well-formed subject is about 6 inches. The manubrium is of somewhat triangular shape, and presents superiorly on each side an oval depression, which receives the sternal end of each clavicle or collar-bone. The lower border is rough and thickened,

and articulates with the gladiolus or second portion. The cartilages of the first rib are attached to the manubrium on each side, and below it forms part of the articulating surface of the cartilage of the second rib on each side. The gladiolus consists in early life of four separate parts, the points of union of which are marked by cross ridges on the surface of the bone. The second rib partly articulates with the gladiolus, whilst the cartilages of the third, fourth, fifth, and sixth ribs wholly, and that of the seventh rib partly, are also attached to this part of the bone. The ensiform cartilage varies in shape in different individuals, and is in any case the smallest of the three pieces of the bone. The cartilage of the seventh rib is in part joined to this appendage, and the structure may be perforated by a hole or aperture. The bony structure of the sternum evinces a delicate cancellated or fibrous-like texture, which is invested by a layer of compact bony tissue. This bone in man is developed from six centres; the manubrium having one of those centres, the gladiolus four, and the ensiform cartilage one. In Vertebrata below man the breast-bone may undergo very considerable modifications. In bats, and in many birds, the most notable feature is the prominent bony ridge or 'keel', serving for the attachment of the pectoral or breast muscles, the great development of which bears a relation to the flying habits of these forms.

STETHOSCOPE (Greek, *stethos*, the chest), an instrument ordinarily consisting of a short wooden tube, from 7 to 12 inches long, widening towards each end, with which physicians are accustomed to examine the internal state of the human body in diseases of the lungs and other internal organs, also in hernia, and the condition of women in pregnancy, &c., by applying the stethoscope to the chest or abdomen, and putting the ear to the wider end. Many disorders may be distinguished very clearly in this way; and the instrument has proved, in the hands of the medical profession, a most useful one. It is the invention of Laennec. The *binaural* stethoscope is now a common form, the instrument having two flexible tubes, the ends of which are applied to both ears simultaneously.

STETTIN, a town and port of Prussia, capital of the province of Pomerania, and of the government of its own name, on the Oder, 17 miles from its entrance into the Stettiner Haff, 30 miles from the Baltic. It stands mainly on the left bank of the river, which is here crossed by several bridges, one of them a large railway swing-bridge connecting the town with its suburbs Lastadie and Silberwiess. The town has greatly expanded recently, more especially since the removal of the extensive fortifications with which it was surrounded. It possesses a number of squares and many well-built and well-paved streets. It is the see of a Protestant bishop, and the seat of a superior provincial court and a number of important public offices. Among its chief buildings are the church of St. Peter, founded in 1124, and the church of St. James, dating from the fourteenth century; the royal castle (1575), now the seat of the provincial government and courts, the new town-hall, exchange, theatre, large new infirmary, and two monumental gateways, formerly in the line of the city ramparts. The industries of Stettin are varied. There are large iron-foundries and engineering works, one ship-building and engineering work employing 4000 to 5000 hands; also chemical works, cement works, sugar-refineries, soap-works, oil-works, flour and other mills, paper and paste-board works, &c., as also famous breweries and distilleries. The shipping and trade are of very great importance, Stettin ranking as the most important port of Prussia. The principal articles of import are, coal, iron, soda

and potash, seeds, coffee, cotton, wine, corn, herrings, timber; the principal exports, sugar, timber, spirits, grain, potatoes, flour. Swinemünde receives much of the import trade that would otherwise come to Stettin, but it has no export trade. Stettin was a town and port of some importance in the twelfth century. In 1121 Boleslas, Duke of Poland, gained possession, and introduced Christianity. The peace of Westphalia gave it to the Swedes. From them it passed to the Prussians, with whom, though not without some interruptions, it has since remained. Pop. in 1880, 91,756; in 1900, 210,680.

**STEBEN, FREDERICK WILLIAM AUGUSTUS, BARON VON**, a distinguished Prussian officer, born 15th November, 1780, who attached himself to the American cause at the revolution of 1776. He had been aide-de-camp to Frederick the Great, and had attained the rank of lieutenant-general in his army. Steuben went to America in 1777, and tendered his services to Congress as a volunteer in the army. He received the thanks of that body, and joined the main army under Washington at Valley Forge. Baron Steuben soon rendered himself particularly useful to the Americans by disciplining the forces; and on the recommendation of Washington, in May, 1778, Congress appointed the baron inspector-general of the army, with the rank of major-general. A complete scheme of exercise and discipline, which he drew up, was adopted in the army by the direction of Congress. At the battle of Monmouth, 28th June, 1778, he was engaged as a volunteer. At the siege of Yorktown he was in the trenches at the head of a division, where he received the first offer of Lord Cornwallis to capitulate. The Marquis de la Fayette appeared to relieve him in the morning; but the baron would not quit his post until the surrender was completed or hostilities recommenced. The matter being referred to Washington, Steuben was suffered to remain in the trenches till the enemy's flag was struck, 9th October, 1781. He continued in the army till the close of the war. Peace being established, he spent the rest of his life in farming, and died 28th November, 1794.

**STEBENVILLE**, a city of the United States, capital of Jefferson county, Ohio, on the west bank of the Ohio River, 68 miles below Pittsburgh. It is situated on an elevated plateau, and contains a courthouse, a high school, a female seminary, &c. There are several woollen factories, blast-furnaces, rolling-mills, machine-shops, breweries, works for railway rolling-stock, paper, glass, white-lead, &c. There are rich mines of bituminous coal in the neighbourhood. Pop. (1890), 13,394.

**STEVENSON, ROBERT**, an eminent Scottish engineer, the son of a Glasgow merchant, was born in that city, 8th June, 1772. He lost his father in early youth, after which his mother married Mr. Thomas Smith, who became engineer to the lighthouse board on its establishment in 1786. Through this connection Stevenson was led to devote himself to the study of engineering, and acquired such proficiency that at the age of nineteen he was intrusted by Mr. Smith with the erection of a lighthouse, which the latter had planned for the island of Little Cumbrae. In 1799 he married the eldest daughter of Mr. Smith, whom he succeeded as engineer and superintendent of lighthouses, an office which he held until 1843, planning and constructing in this period no fewer than twenty-three lighthouses round the coasts of Scotland. His greatest achievement was the construction of the famous Bell Rock Lighthouse, of which he published an interesting account in 1824. Stevenson began operations on the 18th August, 1807, and finished in December, 1810, after surmounting many difficulties and dangers.

In 1814 Sir Walter Scott accompanied Stevenson on one of the periodical voyages which the professional duties of the latter required him to make, a voyage which Scott has graphically described in his diary. (See *BELL ROCK*.) In general capacity as a civil engineer Stevenson was frequently a co-operator with Rennie, Telford, and the other chief engineers of the day. We are indebted to him for the invention of *flashing and intermittent lights*. (See *LIGHTHOUSES*.) He died in Edinburgh, 12th July, 1850. Besides his work on the Bell Rock Lighthouse above referred to, he wrote several articles to the *Encyclopædia Britannica*, the *Edinburgh Encyclopædia*, and other scientific publications. In 1817 he published a series of letters in the *Scots Magazine*, giving an account of his tour in the Netherlands, and describing the engineering works connected with the embankment and drainage of Holland. A biography of him by his son David was published in 1878.

**STEVENSON, ROBERT LOUIS BALFOUR**, novelist, poet, and essayist, was the grandson of the above, being the son of Thomas Stevenson, a lighthouse engineer like his father. Louis was born at Edinburgh, Nov. 13, 1850, and was meant to follow out the family profession, but turned his attention in another direction, and having passed through the Edinburgh University, was called to the Scottish bar, being admitted a member of the faculty of advocates in 1875. Literature, however, turned out to be his real vocation. He had carefully trained himself in writing from his schoolboy days, and thus acquired a style which gave a marked distinction to everything he wrote. An *Inland Voyage* was the first of his books—a charming account of a canoe journey along some of the canals and rivers of Northern France and Belgium, published in 1878. This was followed by *Travels with a Donkey in the Cévennes* (1879); *Virginibus Puerisque* and other Papers (1881); *Familiar Studies of Men and Books* (1882); and *New Arabian Nights* (1882), a series of fantastic tales exhibiting an odd mixture of the commonplace and the extravagant. *Treasure Island* next made its appearance (1883), a brilliant and realistic story of buccaneering days, which immensely widened Stevenson's circle of readers and admirers. *Prince Otto*, an essay in the field of pure romance, appeared in 1885; and the same year *A Child's Garden of Verse* proved how thoroughly the writer could enter into and express a child's thoughts and feelings. The *Strange Case of Dr. Jekyll and Mr. Hyde* (1886), based on the idea of a man possessing a double personality, achieved an extraordinary success with the public. Then came *Kidnapped* (1886), an admirable story of a Scottish boy's adventures in the middle of the 18th century. The adventures of the hero of *Kidnapped* were continued in two subsequent tales, entitled respectively, *David Balfour*, and *Catriona* (1893). The *Black Arrow* (1888) is a story much inferior to some of Stevenson's while the *Master of Ballantrae* (1889) holds a rank next after his best. His volumes of verse—*Underwoods* (1887), and *Ballads* (1891)—possess only moderate merits. A number of his shorter stories were published collectively in *The Merry Men* and other *Tales and Fables* (1887); and in his *Memories and Portraits* (1887) were gathered together a number of magazine articles having a certain autobiographical value. Stevenson's constitution was naturally weakly, and this led him in 1889 to settle in Samoa, where he died on December 8, 1894. His residence in Samoa provided materials for *A Footnote to History: Eight Years of Trouble in Samoa* (1892); and *Island Nights' Entertainments* (1893). Posthumous works are: *Weir of Hermiston*, an unfinished romance (1895), and *St. Ives*, completed by Quiller Couch (1897).

The Vailima Letters appeared in 1895. A collective edition of his works was issued in 1894-97 by Sidney Colvin, who is also preparing a biography.

**STEVENSTON**, a market town of Scotland, in the county of Ayr, 22 miles south-west of Glasgow, with which it is connected by rail. Its handsome parish church, finely situated on a height, looks down upon the straggling, uneven, and narrow street, of about  $\frac{1}{2}$  mile long, of which the town chiefly consists. The principal industries of the town were formerly handloom weaving and flowered muslin sewing, but it is now almost entirely dependent for its prosperity on the neighbouring collieries, blast-furnaces, and a large explosives factory. Pop. (1891), 4261.

**STEWART**, in naval affairs, is an officer in a ship of war appointed by the purser to distribute the different species of provision to the officers and crew. The name is also given to the person who supplies the provisions on board passenger vessels.

**STEWART OF ENGLAND**, LORD HIGH. See **HIGH-STEWART**, COURT OF THE LORD.

**STEWART OF SCOTLAND**, THE HIGH, was an officer of the highest dignity and trust. He administered the crown revenues, superintended the affairs of the household, and possessed the privilege of holding the first place in the army next to the king in the day of battle. The office was held from the beginning of the twelfth century by members of the Allan or Fitz-Allan family, but it had become common in Scotland to call them by the name of the feudal office which they held. When the crown fell to Robert, the seventh high-steward, he became known in history as Robert II., the first of the Stewart (or, as it came afterwards to be written, Stewart or Stuart) dynasty.

**STEWART OF THE HOUSEHOLD**, LORD, in England, is the chief officer of the household of the king or queen; his authority extends over all officers and servants of the royal household except those of the chamber, chapel, and stable. He is always a member of the privy-council; he appoints all the subordinate officers and servants of the household except those of the stable, and also selects the royal tradesmen. His office is held during pleasure, and is vacated when the political party to which he belongs goes out of power. Under the lord-steward in the counting-house are the treasurer of the household, cofferer, controller, clerks of the green cloth, &c. It is called the *counting-house*, because the household accounts are kept in it.

**STEWART**, DUGALD, a celebrated metaphysical writer, was born in the College of Edinburgh on the 22d of November, 1753, his father being professor of mathematics in that university. At the age of seven he was sent to the High School, where, having completed the customary course of education at that seminary, he was entered as a student at the College of Edinburgh. In 1771 he removed to the University of Glasgow in order to attend the lectures of Dr. Reid. The progress which he here made in metaphysical studies was great, and it was here that he composed during the session his admirable Essay on Dreaming, which was afterwards published in the first volume of the *Philosophy of the Human Mind*. The declining state of his father's health compelled him in the autumn of the following year, before he had reached the age of nineteen, to undertake the task of teaching the mathematical classes in the Edinburgh University. As soon as he had completed his twenty-first year he was appointed assistant and successor to his father, and continued to conduct the mathematical studies in the university till his father's death in 1785, when he was nominated to the vacant chair. He did not occupy the chair, however, but exchanged it for that of moral philosophy. In 1792

the first volume of the *Philosophy of the Human Mind* was given to the world. In 1793 he read before the Royal Society of Edinburgh his Account of the Life and Writings of Dr. Adam Smith. In the course of this year also he published the *Outlines of Moral Philosophy*—a work which he used as a text-book. In March, 1796, he read before the Royal Society his Account of the Life and Writings of Dr. Robertson, and in 1802 that of the Life and Writings of Dr. Reid. By these publications alone, which were subsequently combined in one volume quarto, he continued to be known as an author till the appearance of his volume of *Philosophical Essays* in 1810. In the period which intervened between the publication of his first volume of the *Philosophy of the Human Mind* and the appearance of his *Philosophical Essays* he prepared the matter of all his other writings, with the exception of his Dissertation on the Progress of Metaphysical and Ethical Philosophy prefixed to the Supplement of the *Encyclopædia Britannica*. Independent of the prosecution of those metaphysical inquiries, which constitute the substance of his second and third volumes of the *Philosophy of the Human Mind*, to this epoch of his life are to be referred the speculations in which he engaged with respect to the science of political economy, the principles of which he first embodied in a course of lectures, which in 1800 he added as a second course to the lectures which formed the immediate subject of the instruction previously delivered from the moral philosophy chair. So general and extensive was his acquaintance with almost every department of literature and science, and so readily did he arrange his ideas on any subject with a view to their communication to others, that his colleagues frequently, in the event of illness or absence, availed themselves of his assistance in the instruction of their classes. In 1806 he accompanied the Earl of Lauderdale on his mission to Paris; and having already been twice on the Continent he had thus an opportunity of renewing many of the literary intimacies which he had formed in France before the commencement of the revolution. On the accession of the Whig administration in 1806 a sinecure office, that of gazette-writer for Scotland, was erected for the express purpose of rewarding Stewart, who enjoyed with it a salary of £600 a year for the remainder of his life. Shortly after he relinquished the active duties of his chair and removed to Kinneil House, a seat belonging to the Duke of Hamilton, on the banks of the Frith of Forth, about 20 miles from Edinburgh, where he spent the remainder of his days. From this place were dated in succession the *Philosophical Essays* in 1810; the second volume of the *Philosophy of the Human Mind* in 1813; the Preliminary Dissertation to the *Encyclopædia*; the continuation of the second part of the *Philosophy* in 1827; and finally, in 1828, the third volume, containing the *Philosophy of the Active and Moral Powers of Man*—a work which he completed only a few weeks before his death, which occurred on the 11th of June, 1828, at Edinburgh, where he had been on a short visit. He was interred in the Canonigate Churchyard, and a monument has been erected to his memory on the Calton Hill, Edinburgh. He was twice married. An excellent edition of his works, in eleven volumes, enriched with notes, and a biography by Professor Veitch, has been published by Sir William Hamilton.

**STEWART**, FAMILY OF. See **STUART**.

**STEWARTON**, a town of Scotland, in Ayrshire, on the right bank of the Annick, here crossed by three good stone bridges, 15 miles south-west of Glasgow, with which it is connected by the Glasgow, Barrhead, and Kilmarnock Joint Railway. It consists of a main street nearly 1 mile long and several

minor streets. The chief manufactures are Scotch bonnets and hosiery; carpets and lace curtains are also made to some extent; needle-work and spindle-making are among the various minor industries, and there are mills for spinning and carding wool. Pop. (1891), 2687; (1901), 2858.

**STEWARTRY**, in Scotland, the name given to a district under the rule of a steward—an officer appointed by the sovereign, with jurisdiction over crown lands, and with the same power as that of a lord of regality. His jurisdiction, which varied with circumstances, was generally heritable, until the 20 George II. cap. xliii., which abolished all minor stewartries and annexed the rest. The judicial office of steward is the same in everything except name as that of sheriff; and it is declared by 1 Vict. cap. xxxix. that the words sheriff, sheriff-clerk, &c., shall be held to apply to steward, steward-clerk, &c.

**STEWING**, in cookery, a mode of preparing meat and fruit for the table by simmering the materials in a saucepan or stewpan with a little more water than is sufficient merely to keep them from burning. In stewing meat the great art is to keep down the temperature so as to avoid the hardening of the fibres and the too rapid coagulation of the albumen by heat. For this purpose the meat is put into cold water, which is gradually raised to a very low boiling point, what is called a *gallop* never being permitted. It is undoubtedly the most simple and economical, and when skilfully conducted one of the best calculated means of developing the flavour and nutritious qualities of animal food. Stewpans are now almost always rather shallow vessels, with closely-fitting lids, and when used may be heated on a hot plate, or kept at a proper distance from an ordinary fire, or placed in a water bath.

**STEYER**, or **STYR**, a town of Upper Austria, 19 miles south-east of Linz, at the confluence of the Steyer with the Enns. It consists of the town proper and two suburbs, each connected with it by a bridge, and has three squares, one of them elegant, and adorned with fountains, many handsome houses in the Italian style, a town church, modelled on St. Stephen's, Vienna; an old castle on a rocky height, a handsome townhouse, with a museum, &c. Steyer is an important centre for the manufacture of articles of iron and steel, there being here a large work for military firearms, machine works, manufactories of cutlery, awls, files, nails, rings and chains, besides cotton printing works, &c. Pop. (1890), 21,504.

**STICKING-PLASTER**. See **COURT-PLASTER**

**STICKLEBACK** (*Gasterosteus*), a well-known genus of Teleostean Fishes belonging to the family Gasterosteidae (or Triglidæ) and to the division Acanthopterygii of the above order. The family is distinguished by the fact that the soft or membranous part of the first dorsal fin is wanting, the rays forming a series of spines on the back of these fishes. The body is of elongated and compressed shape, and teeth exist in both jaws, but are absent from the tongue and palate. The sides of the body may be covered with bony plates, whilst the other parts are destitute of any scaly covering. The ventral fins are armed with strong spines. These fishes inhabit the rivers and brackish waters of temperate climates. The Three-spined Stickleback (*G. aculeatus*), the Ten-spined species (*G. pugnitiis*), and the Fifteen-spined Stickleback (*G. spinachia*) are familiar species. The last species inhabits the sea, the Three-spined form inhabiting both fresh and salt waters, and being commonly found at the estuaries of rivers. Other species are the *G. gymmnus*, or Quarter-armed Stickleback, sometimes named the Smooth-tailed species; the *G. semiarmatus*, or Half-armed Stickleback; the Half-mailed Stickleback (*G. semiloricatus*);

and the New York Stickleback (*G. Novaboracensis*). The Three-spined or Common Stickleback (ICHTHYOLOGY, Pl. II., fig. 10) is found in almost every English streamlet, and is distinguished by the three spines arming the back. It is a voracious little fish, swimming eagerly after bait of all kinds, and not at all disturbed by noises and acts which would infallibly frighten away most other fishes. They are highly pugnacious fishes, especially at their breeding season. In their reproductive habits they evince many of their most interesting features, being one of the few genera of fishes which construct nests and attend their young with care and affection. The nest is larger than a shilling, and is composed of vegetable matters, pieces of straw and sticks, and the like. In the top or lid of the nest a small hole is formed, and in this the eggs are deposited. The eggs are about the size of poppy seeds, and are of bright-yellow colour. Over this nest and its contained ova these fishes watch with the most jealous care, the male taking upon himself almost the entire duty of nidification, as well as of tending the young after hatching. The Ten-spined species of Stickleback has nine or ten spines on the back, and wants plates on the sides of the body. Its colour is green on the back, and silvery-white on the belly and sides. The fins are yellowish in colour. The average length is 2 inches. The Fifteen-spined Stickleback, or 'Sea-adder,' as it is sometimes also named, lives wholly in the sea. It subsists on Crustacea and allied forms, its stomach frequently containing a very varied assortment of different animals. Its length is from 5 to 7 inches, its colours being a silvery green on the upper parts, a golden tint on the sides, and a silvery white below; fifteen spines exist on the back; the jaws are greatly elongated, and the under jaw protrudes; and the lateral line is provided with keeled scales. The nest made by this species is formed of sea-weeds, and attains the size of the clenched fist. The eggs are distributed in little clusters amid the interstices of the nest, and not in any central cavity.

**STIGMA**. See **PISTIL**.

**STIGMATA**, marks said to have been miraculously impressed on the bodies of certain saintly persons in imitation of the wounds on the crucified body of Christ. The words of St. Paul, 'From henceforth let no man trouble me: for I bear in my body the mark of the Lord Jesus' (Gal. vi. 17), seem to have given rise to the notions promulgated by the Roman Catholic Church respecting the impression of these marks upon the bodies of favoured saints, of which the legend of St. Francis of Assisi furnishes the most remarkable example. It is related of that saint that two years before his death he retired to Mount Alverno, in the lonely region of the Apennines. One day (15th September, 1224), being absorbed, according to the account of St. Bonaventure, in deep and rapt contemplation of our Lord's passion, he saw descending from heaven a seraph with six wings of fire and surrounded by a dazzling light, and having between the wings the figure of a man crucified. After the disappearance of the vision and the return of the saint to calmer thought he found that his hands and feet bore the bloody marks of nails as if he had been crucified himself, and on his side a raw wound, such as would be given by a spear. Since that time several men and a greater number of women have been said to have received all or some of the stigmata; some being also impressed with the marks of the crown of thorns; and others again have felt only an excruciating pain in the seat of the wounds, accompanied by no outward mark. Whatever may be thought of some of these cases there can be little doubt that others have been mere deceptions. See Görres, *Christliche Mystik*, vol. II.

**STILICHO**, the military ruler of the Western Empire under Honorius, was probably the son of a Vandal captain of the barbarian auxiliaries of the Emperor Valens. His prowess, great military skill, and many other eminent qualities, made him dear to the army and invaluable to the Emperor Theodosius. In 384 A.D. he was sent as ambassador to Persia, and his various accomplishments and pleasing manners so won upon the Persian king that a peace was concluded very advantageous to Rome. On Stilicho's return he was appointed commander-in-chief of the army, and was further rewarded with the hand of Serena, the niece and adopted daughter of Theodosius. That emperor having bequeathed the Empire of the East to his son Arcadius, and that of the West to his second son, Honorius, the former was left under the care of Rufinus, and the latter under the guardianship of Stilicho. No sooner was Theodosius no more than Rufinus stirred up an invasion of the Goths in order to procure the sole dominion, which Stilicho put down, and effected the destruction of his rival. After suppressing a revolt in Africa he marched against Alaric, whom he signally defeated at Pollentia. After this, in 406, he repelled an invasion of barbarians, who penetrated into Italy under Rhadagaisus, a Hun or Vandal leader, who formerly accompanied Alaric, and effected the entire destruction both of the force and its leader. Either from motives of policy or state necessity he then entered into a treaty with Alaric, whose pretensions upon the Roman treasury for a subsidy he warmly supported. This conduct excited suspicion of his treachery on the part of Honorius, who massacred all his friends during his absence. He received intelligence of this fact at the camp of Bologna, whence he was obliged to flee to Ravenna. He took shelter in a church, from which he was inveigled by a solemn oath that his life would be spared, and conveyed to immediate execution, which he suffered in a manner worthy his great military character. Stilicho was charged with the design of dethroning Honorius, in order to advance his son Eucherius in his place; and the memory of this distinguished captain has been treated by the ecclesiastical historians with great severity. Zosimus, however, although otherwise unfavourable to him, acquits him of the treason which was laid to his charge; and he will live in the poetry of Claudian as the most distinguished commander of his age. See Gibbon's *Decline and Fall*, ch. xxix. and xxx.

**STILL.** See DISTILLATION.

**STILLING.** See JUNG.

**STILLINGFLEET**, EDWARD, an eminent prelate of the English Church, was born in 1635 at Cranbourne in Dorsetshire, studied at St. John's College, Cambridge, and became a fellow of the college in 1653. In 1655 he was appointed tutor to the brother of the Marquis of Dorchester, and in 1657 was presented to the living of Sutton in Bedfordshire. His first literary work, entitled *Irenicum*, a *Weapon* for the Church's Wounds, or the Divine Right of Particular Forms of Church Government Discussed and Examined, was published in 1659, and reissued in 1662 with the addition of a Discourse concerning the Power of Excommunication in a Christian Church. In the latter year he also published his celebrated *Origines Sacre*, or a Rational Account of the Christian Faith as to the Truth and Divine Authority of the Scriptures, esteemed as one of the ablest defences of revealed religion. At the request of Henchman, bishop of London, he composed *Rational Account of the Grounds of the Protestant Religion*, being a vindication of the Lord-archbishop of Canterbury's Relation of a Conference, &c., which was published in 1664. It was a reply to a book published by a

Jesuit, entitled *Labyrinthus Cantuariensis*, or Dr. Land's Labyrinth. About this time he was appointed preacher to the Rolls Chapel, and in 1665 obtained the living of St. Andrew's, Holborn. He also held the appointment of afternoon lecturer at the Temple church. In 1668 he received the degree of D.D., and being chaplain to Charles II., received from him in 1670 the appointment of canon residentiary of St. Paul's. In 1677 he became Archdeacon of London, and the following year Dean of St. Paul's. An answer to Lord Holles' Letter showing that Bishops are not to be Judges in Parliament in Cases Capital, occasioned by the prosecution of the Earl of Danby, was published by Dr. Stillingfleet in 1679, and entitled *The Grand Question concerning the Bishops' Right to Vote in Parliament in Cases Capital*, stated and argued from the Parliament Rolls and the History of Former Times. On the revival of the Ecclesiastical Commission Court by James II. he declined to become a member of it, and after the Revolution published in 1689 A Discourse concerning the Illegality of the Ecclesiastical Commission, in answer to the Vindication and Defence of it. The previous year he had been appointed Bishop of Worcester. His last work was a Vindication of the Trinity, with an Answer to the Late Objections against it from Scripture, Antiquity, and Reason, in which he made some animadversions on Locke's theory of ideas that gave rise to an acrimonious contest between him and the philosopher. Bishop Stillingfleet died of gout at Westminster on 27th March, 1699, and was interred in Worcester Cathedral. A collected edition of his works, in six folio volumes, was published in 1710.—His grandson, BENJAMIN STILLINGFLEET (born 1702; died 1771), was distinguished as a scholar and writer on natural history, in which he published a series of *Miscellaneous Tracts*, referring more especially to the labours and discoveries of Linnaeus. A poetical Essay on Conversation was contributed by him to the first volume of Dodaley's collection, and attracted considerable attention. He also produced a Treatise on the Principles and Power of Harmony, abridged from Tartini's *Trattato di Musica*, and commenced a General History of Husbandry, which remained unfinished at his death. For his connection with the term *blue-stocking* see that article.

**STILL LIFE**, in painting, the representation of inanimate objects, such as dead animals (game, fishes, &c.), furniture, vases, sometimes with fruits and flowers in addition. The interest of such representations can consist only in the form, grouping, and light; hence the pictures of still life belong to the lowest species of painting. But some scenes of still life are of a higher order than others. The object of the lowest kind is merely to produce a close imitation of nature. A higher kind combines objects so as to form an interesting whole; and the highest employs the objects only to express a poetical idea, as in representing the room of a painter, a table with Christmas presents, the game of a hunter returned from his day's sport. All these may be so represented as to have a poetical character, by reminding us of the individuals with whom they are associated. The Dutch painters Van Aelst, Jan Fyt, Frans Snyders, David Koning, Jan Weenix, Melchior Hondekoeter, Willem Kalf, and Van Streeck are distinguished for the representation of still life.

**STILT** (*Himantopus*), a genus of Grallatorial or Wading Birds, belonging to the sub-family Totaninae, which in turn forms a sub-division of the family Scolopacidae or Snipes. The Stilt genus (*Himantopus*) is distinguished by the long straight bill, and by the opening of the nostrils being elongated and narrowed. The first quill of the wings is the largest. The hinder toe is wanting, the front toes being united by

a membrane at their bases. The Stilt or Stilt Plover (*H. candidus* or *melanopterus*) is so named from the length of the legs. Of this bird, which inhabits swamps in Britain, very little is known. It is a bird of rare occurrence, and although able to swim generally wades up to the belly in the waters of lakes and swamps. The food consists of worms, insects, &c. The wings are of powerful make. The eggs are coloured blue, marked with black and dusky green. This bird exhibits a general white colour, the back and wings in the male being deep black, whilst those of the females are of a brownish-black hue. The beak is black, the legs and toes being reddish. The average length of the stilt is about 12 or 13 inches. The Black-necked American Stilt (*H. nigricollis*) is a bird of similar habits to the Common Stilt, and these birds are described by Wilson as frequenting salt-water marshes, as being gregarious at the breeding seasons, and as making their rough nests of grass, and adding to the structure by degrees so as to raise it above the water-level. In alighting on the ground the legs of these birds are described as being placed in a bent and swaying manner.

STIMULANTS are all those medicinal substances which, applied either externally or internally, have the property of accelerating the pulse and quickening the vital actions. They are among the most valuable and important of medicines, and perhaps are more often the direct means of saving life than any others. But as they are powerful, their injurious effects when misapplied have been even more prejudicial to mankind than their best use has been beneficial. In fact it may be said that the abuse of this one class of medicines, under the names of cardiacs, cordials, alexipharmics, &c., was the cause of more numerous deaths during the dark ages of medicine than the sword and the pestilence united. The dreadful mortality of the small-pox and of fevers during the middle ages, and even during the earlier parts of the last century, were mainly owing to the administration, by nurses and physicians, of strong cordials and heating stimulants of all sorts, the tendency of all of which was to increase the violence of the disease, although they were intended merely to expel the noxious and poisonous humours from the system. But, happily for mankind, a more cautious use of these articles has been introduced, and they are now the constant means of preserving, when properly applied, the life which they were formerly so quick to destroy. Stimulants are either simple and direct in their operation, as the external application of heat in all forms, dry and moist, by friction, &c.; the application to the stomach of hot liquors, spices, camphor, hartshorn, warm and aromatic gums and oils, as mint, cardamom, cajuput, ginger, assafoetida, red pepper, spirits of turpentine, &c.; or they act first as stimulants, but produce afterwards effects of a different character, as is the case with all which are termed *diffusible* stimulants, as wine, brandy, and spirits of all sorts; opium, ammonia, ethers, &c., all of which are highly stimulant at first, and in small quantity; but afterwards, and when taken in larger doses, produce exhaustion, debility, sleep, and death. The first class are upon the whole the most safe, and should be always used in preference to the last when they can be had, in all cases of suspended animation from cold, drowning, suffocation, &c.; while the others are more valuable for their secondary and remote effects, by means of which they ease pain, relieve spasm, &c.; and for these purposes they should be used freely, as they can do no hurt while the violence of the disease subsists. But they should never be resorted to unless pain is urgent, or debility become so great as to endanger life.

STING, or ACULEUS, the name given to certain

kinds of offensive apparatus possessed by animals. In the Bees, Wasps, Hornets, and other insects, the sting is formed by abdominal appendages which, in other insects, appear to form the ovipositor or egg-depositing apparatus. The sting of the Bee consists of an elongated lancet-shaped instrument protected, as within a sheath, by two lateral processes. The lancet communicates internally with a specially-developed gland secreting an irritating or poisonous fluid, which, being injected into the wound, causes the well-known painful effects. The sting in many cases appears to be formed of a double dart beset with barbed teeth or having serrated edges, the poison being sent down within a canal excavated between the darts. The poison-apparatus of serpents is also called their 'sting.'

STINK-POT, an earthen jar charged with powder and materials of an offensive and suffocating smell. It was sometimes used by privateers to annoy an enemy whom they designed to board.

STINT (*Tringa*), a species of Tringine or Sandpipers, belonging to the order of Grallatorial or Wading Birds. Temminck's Stint (*Tringa Temminckii*) is the smallest species of our British Sandpipers, attaining an average length of 5½ inches. Its colour is a dull black, marked with gray on the back; the head being black with rusty-red markings, whilst a light streak encircles the upper eyelid. The wings are of blackish-brown colour. This bird inhabits the edges of lakes and inland rivers. It is said to breed in North Europe.

STIPEND, in Scottish ecclesiastical affairs, the provision made for the support of the parish ministers of the Established Church of Scotland. It consists of money or grain, or both, varying in amount according to the extent of the parish and the state of the free teinds, or of any other fund set aside for that purpose. All stipends originally below £150 are made up to that sum from government funds granted annually to the extent of £10,000, in terms of 50 Geo. III. cap. lxxxiv. By 5 Geo. IV. cap. lxxii. those clergymen of town parishes who have neither manse nor glebe, nor allowance for them, are allowed in addition £50 per annum; those who have no manse are allowed £30, and a like sum is granted to those who have no glebe; those sums to be paid by the exchequer according to a schedule. The commissioners of teinds cannot discern for a stipend or increase of stipend where there are no teinds, as in burghs or in parishes where the teinds are exhausted, or in parishes where a second church is required, a stipend being in these cases derived from voluntary private contributions. By 48 Geo. III. cap. cxxxviii. no augmentation of stipend can be applied for within twenty years after the last augmentation. Whitsunday and Michaelmas are the two terms at which the stipend is held to be payable. Where the incumbent is admitted before Whitsunday he is entitled to the whole year's stipend, and if his interest has ceased before that term he has right to no part of the fruits of that year. If he has been admitted between Whitsunday and Michaelmas he is entitled to the half-year's stipend. On the death of an incumbent a half-year's stipend is to be paid to his executors, one-half of which goes to his widow, the other half being divided among the children or other next-of-kin; or if there is no widow, the whole goes to the next-of-kin. This half-year's stipend, called *ann* or *annat*, is paid in addition to what is otherwise due to the incumbent. The stipend accruing during the vacancy of a living now goes to the Ministers' Widows' Fund.

STIPPLE. See ENGRAVING.

STIPULES, in botany, are organs connected with the leaves, existing only in the dicotyledonous plants,

though not always present. They are small scale-like or leafy appendages at the point where the leaves come off from the stem, and are commonly in pairs, there being one on each side of the petiole, as in the hornbeam and lime. They are more frequently free, not being attached to the petiole; but at other times they are united to the base of that organ, as in the genus *Rosa*. The stipules afford excellent characters for the arrangement of plants. When a vegetable of a natural order has these organs, it is very seldom the case that all the others are not equally provided with them. Thus they exist in all plants of the natural orders Leguminosæ, Rosacæ, Tiliacæ, &c. As they fall off very easily when they are free, their absence might sometimes induce one to suppose a plant destitute of them, but this error may be avoided by observing that they always leave on the stem, at the place where they are attached, a small cicatrix, which attests the fact of their having existed. They vary greatly in their nature and consistence; thus they may be foliaceous or leaf-like, as in the common agrimony; membranous, as in the fig and magnolia; spinescent or thorny, as in the jujube and gooseberry. Some fall off before the leaves, as in the common fig and the lime; others are merely deciduous, or fall at the same time as the leaves; and there are others which continue for a longer or shorter time after the leaves have fallen, as in the jujube, gooseberry, &c. The use of the stipules appears to be to protect the leaves before their expansion, as is evidently shown by their relative disposition in the buds of some orders of plants.

**STIRLING**, or **STIRLINGSHIRE**, a county of Scotland, bounded on the north by Perthshire, from which it is partly separated by the Forth; on the east by the Firth of Forth and Linlithgowshire, from which it is separated chiefly by the Avon; on the south by Linlithgowshire, Dumbartonshire, and Lanarkshire; and on the west by Dumbartonshire and Loch Lomond; greatest length, east to west, 36 miles; central breadth, north to south, about 18 miles; area, 464 square miles, or 296,928 acres. It is of very irregular shape, and has also a greatly diversified surface, rising in the north-west, on the shores of Loch Lomond, into the lofty Ben Lomond (which see), and traversed towards its centre by the Gargunnoch, Fintry, and Campsie Hills, while it slopes down towards the banks of the Forth, and spreads out into two of the largest and richest alluvial plains in the kingdom, known by the name of the carse of Stirling and Falkirk. The principal rivers are the Forth, with its tributaries Carron and Avon, the Endrick, which flows into Loch Lomond, and the Kelvin, a tributary of the Clyde. The lakes, in addition to Loch Lomond (See **LOMOND**, **LOCH**), which it shares with Dumbartonshire, are numerous, but for the most part insignificant. In the mountainous district of the west the prevailing rocks are mica and chlorite slates. Immediately east and south of the slate, the old red sandstone becomes the prevailing formation, extending east along the banks of the Forth nearly to the town of Stirling, and south to the range of the Campsie Fells. That range consists almost entirely of porphyry and trap, but on some of its southern slopes, and still more in the carse east of it, the carboniferous formation becomes largely developed, and several valuable coal-fields are extensively worked both for domestic use, the supply of iron-works, of which those of Carron are most important, and for exportation, chiefly by the shipping port of Grangemouth. The more elevated and rugged parts of the county are necessarily devoted to pasture; the hills, where not too lofty or sterile, are in general well wooded; the valleys and undulating slopes, and more especially the alluvial

plains, are fertile, the last more especially in the highest degree, and are under a system of agriculture as advanced as any of which Scotland can boast. Of the total area rather less than half is described as mountain and heath land used for grazing, and 15,000 acres are under woods and plantations. About 26,000 acres are under corn crops, oats being much the most important, and 8000 acres are under green crops, chiefly turnips and potatoes. Rather more than 50,000 acres are permanent pasture. The plains are admirably adapted for the growth of fruit-trees, and almost every farm has an orchard, which often adds no inconsiderable item to the value of its produce. The chief branches of industry are mining, the smelting, casting, and working of iron; and the manufacture of woollens and leather. The means of communication are, except in the mountainous districts, very ample, both by land and water, including the Caledonian and North British Railways, the River Forth, and the Forth and Clyde Canal. The county sends one member to Parliament. The chief towns are Stirling (the capital), Falkirk, and Grangemouth. Pop. (1881), 112,443; (1891), 125,604.

**STIRLING** (formerly *Styrrelgyn* or *Estrivelin*), a royal, municipal, and parliamentary burgh and river-port of Scotland, capital of the above county, beautifully situated on a commanding height overlooking the windings of the Forth, where it first ceases to be navigable, 31 miles W.N.W. of Edinburgh, and 29 miles north-east of Glasgow by rail. The river is spanned here by two bridges, one of them ancient, the other a handsome modern structure. The town consists of an ancient portion, which is very irregularly laid out, and formed of steep winding streets, climbing the height towards the castle; and of a modern portion, situated on the lower ground, and composed for the most part of handsome modern houses. The most important edifice in Stirling is the castle, which, with the rock on which it stands, forms a conspicuous object, not only to the country immediately around, but to several adjoining and even to some distant counties. It crowns a rocky eminence, which rises 220 feet above the plain, and terminates precipitously on the north-west side of the town. The earliest fortifications of this eminence are attributed to the Roman general Agricola, and its importance as a military station is proved by the Roman road which passes immediately beneath it. As early as the tenth century Stirling begins to hold a prominent place in Scottish history, and few important events took place, while Scotland formed a separate kingdom, in which it did not share. Almost every apartment in the castle has some tale of thrilling interest or horror. The principal parts of it as they now stand are the royal palace (rebuilt after a fire in 1855), in a chamber adjoining which, still known as the Douglas room, a turbulent earl of that name was mortally stabbed by James II., while in another apartment the same James, as well as James V., was born; the Parliament House, once a noble fabric, and still of imposing exterior, though completely defaced within by having been converted into mess-rooms and other accommodations; the chapel-royal, now used as store-rooms; and another palace begun by James IV., and finished by his unhappy granddaughter Mary, and more remarkable for the grotesque figures which are conspicuous features of the building. From the battlements of the castle there is a splendid view of the surrounding country, comprehending the fertile Vale of Menteith, Ben Lomond, Benvenne, Ben A'an, Ben Ledi, and Ben Voirlich, the Ochil Hills, the windings of the Forth, the ruins of Cambuskenneth Abbey, the Abbey Craig with Wallace's Monument, and Bridge of Allan. Other objects within the town deserving of notice

are the old church, known as Greyfriars, which was begun by James IV., a large and handsome structure with a massive and lofty tower, now entirely defaced as to its internal appearance by a partition dividing it into two parish churches (the East and West); the North Parish church; places of worship for various other denominations; a high school, and several public schools; a town-house with a spire; handsome new county buildings; a curious old residence of the Earls of Mar, called Mar's Work; an old mansion called Argyle's Lodging, once occupied by the Argyle family, in the French castellated architecture so common in Scotland; a fine arcade with town-hall; the Smith Institute, with library, reading-room, museum and picture-gallery; a new public hall, &c. The principal manufactures are woollens, carpets, leather, ropes, and carriages. The trade is not of much importance. The salmon-fishings of the Forth have long formed an important source of revenue. Stirling is supposed to have been first incorporated as a royal burgh by David I., and now, under the Reform Act of 1832, unites with Dumfermline, Culros, Inverkeithing, and South Queensferry, all being known as the Stirling burghs, in sending a member to Parliament. Pop. in 1881, 16,012; in 1891, 16,895; in 1901, 18,403.

**STIRLING, EARL OF.** See ALEXANDER (WILLIAM).

**STIRRUP.** The ancients were not acquainted with the use of this convenient article of equestrian equipment, the Emperor Mauritius, who flourished towards the end of the sixth century, being the first writer who makes mention of it in his *Treatise on the Military Art*. The Roman youth were accustomed to leap upon their horses sword or lance in hand. A jasper, explained by Winckelmann; a *basso-relievo*, engraved by Roccheggiani; and the painting of a Greek vase, published in Millin's *Recueil de Monumens*, all exhibit warriors mounting on horseback by the help of a cramp-iron attached to the pike or lance. Distinguished persons and old men had servants to place them on their horses, and conquered sovereigns were often compelled to perform this office for their vanquishers.

**STIRRUPS** (naval) are ropes with eyes at their ends through which the foot-ropes are rove, and by which they are supported; the ends are nailed to the yards, and steady the men when reefing or furling sail.

**STOAT.** See ERMINE.

**STOCK**, or **STOCK GILLYFLOWER** (*Mathiola*), a genus of plants of the natural order Cruciferae, having tapering pods, converging stigmas thickened at the back, a calyx with two saccate sepals, and compressed seeds arranged in a single row, and surrounded by a thin membranous border. There are several species, natives of Europe and of Barbary; two species, the common gillyflower (*M. incana*), and *M. sinuata*, a variety with large purple flowers, which are exceedingly fragrant, but only during the night, are indigenous to Britain. They have been long favourites of the flower-garden, the double species being esteemed for the beauty and deep tints of the flowers, and their delightful odour. Of the Common, or Ten Weeks' Stock, and the Smooth-leaved (*M. glabra*), there are not less than one hundred varieties, generally called German Stocks. The Simple or Brompton Stock (*M. simplicicaulis*) is a biennial, of which there are also several varieties. The Virginia Stock (*Malcolmia maritima*) belongs to a different genus, though of the same natural order. It has been introduced into Britain from the Mediterranean coasts, and is now held in great esteem, not only on account of its beauty and fragrance, but because it thrives well in gardens exposed to a smoky city atmosphere.

**STOCK EXCHANGE**, a market for the purchase and sale of public stocks, shares, and other securities of a similar nature. In London it appears that transactions of this kind were conducted in the eighteenth century partly in the rotunda of the Bank of England, but chiefly in the rooms of Stock Exchange Coffee House in Threadneedle Street. At the beginning of the nineteenth century the increasing business became too much for the rooms, and a site was purchased near Capel Court where a spacious building was erected for the accommodation of stock brokers and jobbers. The first organized association of this nature in New York was founded in 1817, and became finally located in the handsome buildings erected in 1865 on a site surrounded by Broad Street, New Street, and Wall Street. The London and New York stock exchanges are the chief associations of their kind in the world; after them come those of Paris, Amsterdam, Frankfort, Berlin, Vienna, and St. Petersburg. At present nearly every important commercial city in both hemispheres has its stock exchange.—The management and methods of transacting business are in the more important respects controlled by regulations of much the same character and force the whole world over. In most instances a president and committee are appointed by the members from their own number, and these form the executive of the exchange and can admit, suspend, or expel members. Each member must pay a certain sum as entry money, furnish substantial securities that he will be honourable in his dealings, and pay an annual subscription to meet the expenses of the association, as rent, telegrams, printing, officials' salaries, &c. Should a member become unable to meet his liabilities he is expelled or suspended, the claims against him are made good from his securities, and his name is entered in a list of defaulters, or *lame ducks*. The members of the London Exchange are divided into two classes: *jobbers*, who deal on their own account; and *brokers*, who act for a client, deal with the jobbers, and are paid by commission. A broker may, and generally does deal in a considerable number of shares, but he does not himself operate on the exchange, his purchases and sales being all effected by a jobber, who has no business relations at all with the outside public. In the provincial stock exchanges no such classification obtains, all members dealing directly with the general public. Stock exchanges perform a number of useful functions, only a few of which we can indicate. The body of dealers find it convenient, not to say necessary, to have a place where they may meet to transact business among themselves; here they have the advantage of the latest intelligence, secured for the most part through the instrumentality of the exchanges themselves, from all the leading associations of the same kind throughout the world. The result is that, owing to the keen competition of the buyers and sellers, prices are promptly adjusted to existing conditions of supply and demand, and excessive and ruinous fluctuations in the prices of securities are thus obviated. The value of government stock is considerably influenced by the confidence the public has in the stability of the government, hence the rumour of a victory or of the outbreak of a serious war produces a rise or fall of prices. The declaration of a good or bad dividend on mining or railway shares, the report of an increase or decrease in the output or traffic in the concern often brings about an undue exaltation or depreciation in the market value of its securities. The stock broker or dealer in the case of an undue confidence sells his shares freely, and thus arrests the rise; in the case of an irrational panic he buys largely, and thus arrests a fall. See STOCK-JOBBER.

**STOCK-FISH**, the name given in commerce to salted and dried cod, hake, ling, and other fish of the same family. For the method of curing see COD.

**STOCKHOLM**, a city of Northern Europe, the capital of Sweden, beautifully and picturesquely situated between Lake Mälär and the Baltic, 330 miles north-east of Copenhagen, and 440 miles w.s.w. of St. Petersburg. It stands partly on the north and south sides of the strait that communicates between the lake and the sea, and partly on several islands, which are connected with the mainland and with each other by a number of bridges. The finest of these bridges are the Norrbrö and Vasabro (the latter completed in 1878), which join the largest of the islands, the Staden or City, with the north side of the strait. When approached from the Baltic the appearance presented by the city is very grand and imposing; but a still better view is obtained from the Mosebacke, a rugged hill on the south side of the mainland, from the summit of which the eye takes in the whole city and its environs, and beholds a panorama which in many respects resembles that of Venice, but far surpasses it in natural beauty. The oldest part of Stockholm, or the city proper, is situated on the island of Gustavsholm (usually called the Staden), and on the smaller adjacent islands of Riddarsholm, and Helgeandsholm. It is the smallest part, but the closest built and most densely peopled. It consists for the most part of narrow and crooked streets and lanes, though, from its antiquity, many of the most interesting objects which the town possesses are situated within it. Norrmalm on the north (with its eastern and western extensions of Ladugårdslandet and Kungsholmen), separated from the city proper by the Norrström, and Södermalm on the south, separated from it by the Söderström, though considered only as its suburbs, far surpass it both in extent and regularity of structure. Norrmalm contains the principal hotels, the railway-station, and the best shops. The houses in the city are generally of stone, but in the suburbs more frequently of brick, stuccoed over, and coloured white, yellow, or light blue. An eastern suburb is that of the Djurgården on an island two miles long.

The public buildings are numerous, but not very remarkable. By far the finest is the palace, situated on the highest part of Gustavsholm. It was commenced in 1697, and was completed in 1760. It is built in the form of a quadrangle, with two wings, and incloses a large court. The basement story is of granite, the rest brick and stucco. The finest front is the south-east, which is adorned with six Corinthian pillars. The whole structure is chaste, simple, massive, and finely proportioned. Few of the churches possess much architectural merit. The oldest is St. Nicholas (Stor Kyrka or Great Church), in which the sovereigns are crowned. It was founded in 1264, but has undergone so many changes that the original building has disappeared. It is surmounted by a lofty tower. The Riddarsholm Kyrka or church possesses considerable historical interest, both from the scenes which have taken place in it, and from containing the ashes of a long line of Swedish monarchs. Its style was originally Gothic, but it has been much defaced by modern alterations. The church of Adolphus Frederick, in the Norrmalm, is built in the form of a cross, and has an elegant tower crowned by a copper dome. In Norrmalm is situated the National Library (erected in 1870-76), containing upwards of 250,000 printed books and 8000 MSS. On the northern mainland stand also the National Museum, a handsome building in the Renaissance style containing large collections of antiquities, coins, drawings and engravings, sculpture, &c. The chief other public edifices deserving of notice are the

governor's house, a handsome structure facing the quay, on which a granite obelisk in honour of Gustavus III. has been erected; the Riddarhus, where the upper chamber formerly met; the Rigsdagshus (parliament-house); the exchange, the mint, of little merit as a building, but with a good collection of minerals; the townhouse, a large pile, in which the principal courts of justice are accommodated; the ethnographical museum, containing a very interesting collection of Scandinavian antiquities; the post-office, merchant-house, royal theatre and opera-house, the arsenal, and barracks. Among the educational establishments are a medical college, a technological institute (occupying a handsome building), a navigation school, a school of design, &c. The principal benevolent institutions are a blind and deaf and dumb asylum, a lunatic asylum, the Seraphim infirmary, Danvik's hospital, the burgess widows' hospital, and the garrison infirmary. The associations, literary, scientific, artistic, &c., are very numerous, and include, among others, the Academy of Sciences, in which the celebrated chemist Berzelius long held a distinguished place; the Swedish Academy, the Academy of History and Antiquities, the Musical Academy; and Medical, Agricultural, and Horticultural Societies. Few cities can boast of finer promenades and recreation grounds. Of these the most frequented are the Djurgården, a fine park or garden on the island already mentioned, remarkable for its picturesque beauties, its magnificent trees and drives; the Haga park and gardens, and the park of Carlberg, finely planted, and connected with the city by a long and beautiful avenue.

The manufactures consist chiefly of woollen, linen, cotton, and silk goods; porcelain and stoneware, glass, tobacco, refined sugar, ironware, including large castings and machinery. The trade has the advantage of a harbour which, though somewhat difficult of access, from the length and intricacy of the channels which lead to it, is capacious, and has depth of water sufficient for the largest vessels at its quays. The principal exports are iron, copper, tar, and timber; the imports, colonial produce, wine, fruit, salt, &c. The inland trade is also of considerable extent.

Stockholm was founded about 1260, by Birger Jarl. It was fortified at an early period, and stood several sieges. One of the most memorable of these was in 1501, when it was defended against the Swedes for the crown of Denmark by the Danish queen Christina: another still more memorable was in 1520, when an equally heroic female, Christina Gyllenstierna, widow of Sten Sture, held it for the Swedes against the perfidious and sanguinary Christian II. The capitulation made was shamefully violated by the king, who, after pledging himself to respect the rights of the inhabitants, was guilty of the most atrocious massacres. The indignation which was thus produced in all quarters of the country paved the way for the war of Liberation, which, conducted by Gustavus Vasa, at length terminated gloriously by the expulsion of the Danes, and the establishment of Sweden as an independent kingdom. Pop. (1882), 185,325; (1898), 295,789.

**STOCKINGS.** See HOSIERY.

**STOCK-JOBGING.** The practice to which the term stock-jobbing is more particularly applicable is that which is carried on amongst persons who possess but little or no property in any of the funds, yet who contract for the sale or transfer of stock at some future period, the latter part of the day, or the next settling day, at a price agreed on at the time. Such bargains are called *time bargains*, and this practice is *gambling* in every sense of the word. The business of jobbing is carried on to an amazing extent,

and is of this character:—A. agrees to sell B. £10,000 of bank stock, to be transferred in twenty days, for £12,000. A., in fact, does not possess any such property; yet if the price of bank stock on the day appointed for the transfer should be only £118 per cent, he may then purchase as much as will enable him to fulfil his bargain for £11,800; and thus he would gain £200 by the transaction. Should the price of bank stock advance to 25 per cent, he will then lose £500 by completing his agreement. As neither A. nor B., however, may have the means to purchase stock to the extent agreed on, the business is commonly arranged by the payment of the difference—the profit or the loss—between the current price of the stock on the day appointed and the price bargained for. The buyer in these contracts is denominated a *bull*, and the seller a *bear*. This practice is nothing more than a wager as to what will be the price of stocks at a fixed period; but the facility which it affords to extravagant and unprincipled speculation, and the mischief and ruin which frequently followed it, determined the legislature to lay a penalty of £500 on every person making such time-bargains; and the like sum on all brokers, agents, and scriveners employed in transacting or writing the said contracts. By the same statute also (7 Geo. II. cap. viii.) a similar penalty was imposed upon all persons contracting for the sale of stock of which they were not possessed at the time of such bargain, and £100 on every broker or agent employed in procuring the said bargain. The difficulty, however, of distinguishing between legitimate and illegitimate transactions determined the legislature again to repeal this act by 23 and 24 Vict. cap. xxviii. (1860).

**STOCKPORT**, a parl., county, and municipal borough in England, partly in Cheshire and partly in Lancashire, 5 miles south-east of Manchester, on the Mersey. It occupies an elevated, uneven, and rugged site, on which the houses rise in irregular tiers, giving it at all times a picturesque, and at night, when its various buildings are lighted up, a very striking appearance. The streets, though somewhat steep and narrow, are well paved. The ecclesiastical edifices include the parish church of St. Mary, a handsome structure in the later English style, with an ancient chancel, a lofty pinnacled tower, and a peal of eight bells; St. Thomas' church, an elegant building in the Grecian style, with a tower crowned by a cupola; St. George's church, a large and fine edifice of recent erection; St. Peter's church, a neat brick building with a square tower; Christ Church, with a fine spire; St. Paul's church, and St. Matthew's; there are also some handsome places of worship belonging to other denominations. The schools include the grammar, technical, and other schools, among which is the Stockport Sunday-school, with its four branch schools, attended by about 5000 children. Other institutions and buildings are the mechanics' institute; the infirmary, occupying a handsome stone building, whose site renders it one of the most conspicuous objects in passing through the town; the theatre; the free library, containing about 19,000 vols., and news-room; the borough cemetery, with two small but handsome chapels; another cemetery; and the railway viaduct on the London and North-Western Railway, a magnificent structure which spans a great portion of the town, including the river Mersey; &c. There are beautiful parks and fine recreation grounds. The cotton manufacture is the staple of the town, and, in addition to numerous large factories, there are several print, bleach, and dye works, also many large and important hat manufactories. There are engine and machine shops, iron and brass foundries,

breweries, and brick-works. It sends two members to Parliament. Pop. of parl. bor. (1891), 70,263; (1901), 78,871; of co. bor. (1901), 92,806.

**STOCKS**, a wooden apparatus to put the legs of offenders in, formerly used for the restraining of disorderly persons, or as a punishment for certain offences.

**STOCKTON**, a city of the United States, capital of San Joaquin county, California, on a slough or canal containing the backwater formed by the junction of the San Joaquin and Sacramento, 59 miles from Vallejo. It is situated in a central position in the valleys of the Sacramento and San Joaquin, making it the depôt for all the south mines. It is regularly visited by steamers. Pop. (1890), 14,424.

**STOCKTON (STOCKTON-UPON-TEES)**, a market-town, parliamentary and municipal borough of England, mainly in the county of Durham, on the Tees, across which is a fine stone and iron bridge. It is well built, and has a town-house, a borough hall, custom-house, many fine churches and chapels, good quays, steam tramways, &c. As a parliamentary borough Stockton includes Thornaby-on-Tees, on the south bank of the river Tees, situated in the North Riding of Yorkshire, and now forming a separate municipal borough. The parliamentary borough returns one member to the House of Commons. Formerly the manufactures consisted chiefly of linen and sail-cloth, but the vicinity of the Cleveland district has led to the erection of extensive iron-works, consisting of smelting and puddling furnaces, rolling-mills, and other apparatus for the manufacture of rails, bars, plates, &c.; also foundries and works for the manufacture of marine-engines, iron bridges, and boilers, gas-holders, &c. There are several iron ship-building yards, potteries, bottle-works, &c. In the main street, which is spacious, there is a new exchange, and other handsome buildings. The town possesses an extensive park. A good trade is carried on by the river, which enters the sea 4 miles below. Pop. in 1891, parl. bor., 68,895; mun. bor., 49,708; in 1901, 71,812 and 51,476.

**STOICS**, a sect of philosophers which flourished first in Greece and subsequently in Rome, so called from the porch, *Stoa*, at Athens, where Zeno, its founder, taught. It was about B.C. 308, fourteen years after the death of Aristotle and thirty-nine years after the death of Plato, that Zeno laid the foundations of the new school. Almost at the same time (B.C. 306) Epicurus began to teach in Athens. The academy under Speusippus and Xenocrates had passed through the phases of pantheism and mysticism, and under Arcesilaus had begun to fall under the influence of scepticism, while the followers of Aristotle had abandoned the higher walks of philosophy for the study of nature and the popularization of morals. Out of the void thus created in the world of philosophy arose these two new schools (Stoics and Epicureans), in many respects opposed to each other, and destined to run a career of rivalry. The stoical school has no successor in modern philosophy; the Epicurean, in its essential principles, survives and flourishes. The services of the respective systems to philosophy and to human society must not, however, be measured wholly by their duration. The stoical school was characterized by a narrow adaptation to circumstances in their own nature transitory, which at once fitted it for a special work and prevented its survival. The Epicurean, with its bolder speculation and laxer morality, has at least proved by its survival in essential parts its adaptation to certain permanent phases of human thought and principles of human action. For a further comparison of the twin systems we can only here refer to the article *EPICUREUS* and the remainder of this article.

The history of stoicism is remarkable. Founded in Greece, and receiving there within a brief period almost its entire systematic development, it seems to have been specially adapted to flourish in Rome, and once transplanted into the congenial soil of that great commonwealth it attracted to itself the noblest, the most vigorous, and the most typical minds which for a succession of ages its eventful history produced, so that Roman virtue became almost identified with stoicism, and pagan Rome and stoicism may be said to have expired together. What renders this association more striking is that it was Greece in decline and degeneracy which gave this form of rude and active virtue to Rome. It was the active, social, and severely self-denying principles in the standard of duty inculcated by the Stoics that commended their philosophy to the preference of the noblest spirits of Rome.

Among the leading Stoics of Greece may be mentioned Cleanthes, Chrysippus, Zeno of Tarsus, and Diogenes of Seleucia, surnamed the Babylonian, who followed each other as heads of the school in succession to Zeno; Panætius of Rhodes, a disciple of Diogenes, who introduced the Stoic philosophy, with some modifications and an infusion of the elder philosophy of Greece, into Rome, and his disciple Posidonius of Rhodes, the instructor of Cicero. Among the Romans stoicism was embraced by statesmen such as Cato of Utica, Cicero, and Brutus, and had among its expositors Cicero, Seneca, and Epictetus. In the later days of the empire stoicism modified itself greatly in the direction of conformity with the prevailing spirit of Christianity. This is especially manifest in the teaching of Epictetus. The Emperor Marcus Aurelius Antoninus may be said to be the last, as he was one of the greatest, of the Stoics. Zeno and his disciples, Cleanthes and Chrysippus, almost completed the development of stoicism as a speculative system; in the hands of the Romans it became more and more a practical system of morals. It is commonly understood that the systematic development of stoicism was the work of Chrysippus, but Ritter is of opinion that Chrysippus was chiefly successful as a polemic in defending his school against the academics and Epicureans, and that he added little to its doctrine. In this case Zeno himself must have been the chief constructor of the system, as the chief care of Cleanthes, his successor, who had been a pugilist, and who worked by night at drawing water that he might give his days to the study of philosophy, was to keep pure the doctrine of his master, to whom he was zealously attached.

Zeno, who lived to a great age, was held in high respect by the Athenians. None of his works have been preserved. Cleanthes wrote much, but a hymn to Zeus is the only complete production of his extant. Chrysippus was a very voluminous writer. He is said to have written 600 lines a day, and composed 700 works; but they contained numerous quotations, repetitions, and amendments. None of them are extant. Zeno was successively a pupil of Crates the Cynic, Stilpo the Megarian, and Xenocrates and Polemo the Academics. The leading principles of stoical morality can be distinctly traced to Antisthenes, the disciple of Socrates, and founder of the cynical school.

Stoicism is not a consistent system, and has added nothing of value to speculative philosophy. The aim of its founder was ethical, and he appears to have succeeded in stamping his system with a form so peculiar as only to have attracted minds in sympathy with his own purpose, so that this character of the school became more and more distinctive till its latest day. Chrysippus, who was regarded by subsequent Stoics as the great authority of the school,

at first adopted the Academic philosophy, and disputed with Cleanthes, but he was alienated from the Academics by their scepticism, and drawn to the Stoics by their assertion of the certainty of knowledge. He is said to have requested Cleanthes to teach him only the principles of the school, and he himself would find arguments to defend it. In respect to the practical aim of their philosophy the Stoics may justly be regarded as being, as they professed to be, the followers of Socrates.

The Stoics divide philosophy into three departments—logic, physics, and ethics. Logic includes dialectic and rhetoric, physics cosmology and theology, and ethics politics. In the classification of Cleanthes all six are specified. In each of these departments there is a fundamental principle different from that of the others; to give unity to the system, these principles have to be reconciled; the reconciliation at best is only artificially attained, and from this non-identity of principle result incoherence and contradiction. This is the rock on which stoicism as a system split. Want of unity of principle is the heritage it derives from the degeneracy of the period from which it sprang. Out of the wreck of Greek philosophy it has only succeeded in saving some fragments for practical use.

The logic of the Stoics was based on Aristotle. The foundation of their dialectic was the Aristotelian principle, which has been expressed by the schoolmen in the maxim, 'Nihil est in intellectu quod non prius fuerit in sensu.' In conformity with this maxim they make the mind a *tabula rasa*, and reason itself a sense. But the development of their dialectic is not consistent with its foundation. They adopted the idealistic form of conception, but not finding in it the ground of certainty which they sought, they amended it by a theory of immediate perception. The representations of things are formed by the senses on the mind; but in perfectly clear perception the mind, as it were, goes out from itself and grasps the object.<sup>1</sup> The criterion of certainty with the Stoics is thus the perfection of sensuous representation. All images in the mind ought thus to be individual representations of sensuous objects; but having got these images into the mind, the Stoics proceed to give the mind an active power to elaborate them in such a manner as to form judgments, general principles, and in a word, knowledge. Of these judgments they formed a regular hierarchy; a judgment consisting of a synthesis of sensations; a generalization of a synthesis of judgments, and science of a universal synthesis of generalizations. In the elaboration of this system some Stoics got so far as to admit ideas independent of experience, which they called anticipations.

The inconsistency of the stoical dialectic is partly explained by their physics; but it is still more difficult to get a consistent whole out of the physics than out of the dialectic. According to the Stoics everything real is material; besides matter there is nothing but abstractions which have no actual existence. The definition of matter thus becomes a matter of primary importance in the stoical philosophy, and it is given clearly enough. Matter consists of two elements—a passive formless element, susceptible of motion and form; and an active moving and moulding element. These two elements are never separated except in abstraction. When we have got thus far all clearness is at an end. In naming the elements we have the recurrence of the term matter as representing the passive element, in opposition to force

<sup>1</sup> Zeno defined the *fantasia* or representative perception as an impression on the soul; Chrysippus as an alteration in the soul, producing a state in which both object and subject are revealed.

or energy, as representing the active. We no longer know, in dealing with matter, whether it is an abstract element or an existing combination we have to do with. Even the element of force appears to be represented as material, on the ground that without a body to act or be acted on there can be neither action nor passion. The word matter is thus deprived of all distinctness of meaning; it appears capable of signifying either element, or both in combination. The only circumstance which seems to afford any clue in this labyrinth is the hypothesis which seems to be implied from the reasoning of the Stoics, that in various forms of matter in the concrete the two elements may be combined in different proportions; but even this will afford only partial help. Mind, intellect, or reason is represented by the active force of matter, which is immanent in the passive. God is the working force of the universe. It would thus seem as if God were an element, and intelligence had only an abstract or elementary existence; yet in the existence of such an element in all matter we have an explanation of the dialectical inconsistency which gives an active energy to a purely sensuous mind. The beauty and harmony of the world prove that God is essentially reasonable and intelligent. He is also a Providence who governs all things by reason and wisdom. Here something more than a merely elemental intelligence is implied. The cosmology of the Stoics begins with an account of the substance of the Deity, and it is somewhat remarkable that as Epicurus went back to Democritus for the basis of his cosmology, Zeno borrowed his from Heraclitus, and makes fire the first principle of all things. In relation to the creation of the world God is represented both as the germ or seed, and as the reason or cause of all things. He is described as an artistically creative fire. He permeates the created world as an all-pervading breath, and is identified or confounded with nature. The heathen gods are explained as being representatives of the Deity under different aspects of his nature. In the system of the universe all things have an end and accomplish it. Nothing is left to chance. There are four material elements, or rather, it would appear, forms of the combined elements of matter—fire, air, water, and earth. The energy is greater in the more ethereal, and less in the grosser forms. The formation of the world takes place by the transformation of the divine original fire into water, one-third of which becomes earth, one-third is converted into air and again back into fire, while a third remains water. The principle of life is heat. The highest rational fire dwells in the purest matter. Of the four elementary forms of matter, water and earth are mainly passive, fire and air mainly active. At the end of a cosmical period the universe is reunited by a general conflagration with the Deity. Panætius and Posidonius rejected this theory, and affirmed the imperishability of the world. Those who admitted this cosmical revolution held that by a necessity amounting to fate the new world evolved after the destruction of the old was in all respects identical with its predecessor. The soul was held to outlive the body, but not the cosmical period. Some held that only the perfect man, or sage, survived to the close of the cosmical period. Cleanthes held the former opinion, Chrysippus the latter. As all things recur in the new period, this would apparently give at least an intermittent immortality to the wicked or foolish; but some Stoics did not hold fate to be absolutely unchangeable, but excepted from it evil, which does not come from the Deity. Chrysippus reconciled fate with liberty by limiting it to auxiliary causes, and thus freeing mind from its influence. The human soul is a breath from the

Deity, which pervades the body. It consists of eight parts—reason, the five senses, speech, and the powers of generation. The world is bounded and spherical; beyond it exists an unlimited void. All individual things are different from each other.

The ethics of the Stoics, which in strict theory should be subordinate to their physics, is the most important part of their system, and stands out in marked contrast with the former part of it, and especially with the dialectic. Its fundamental principle is liberty. This is the practical end of the system, and the exposition of the views of human conduct which are deemed conducive to the attainment of this end is the chief concern of its masters. A tardy intellectualism is thus in reality the dominant principle of a system apparently based exclusively on the sensuous and material. The moral theories of the Stoics, however, are not free from the influence of their physics and dialectic, and the stoical morality thus acquires the aspect of a struggle against fate, the possibilities of which vary with the views of the particular moralist. Zeno held the proper end of human morals to be action and not contemplation, and the proper sphere of human activity to be social and political life. In this view he is well supported by his followers. Zeno defined the end of morals as harmony with one's own nature, Cleanthes as harmony with universal nature, Chrysippus as harmony with the nature of man and of the universe combined. The end of morality is otherwise defined as conformity to reason, a definition which in the stoical system is equivalent to the preceding ones, which seem to differ rather in explicitness than in intrinsic significance. The model of the stoical morality is the sage, who is represented as not inferior except in non-essentials to Zeus, and who is as profitable to Zeus as Zeus is to him. He acquires this superiority by subduing his passions, which are the enemies of liberty. The Stoics recognize three degrees of moral quality in actions; besides those which are positively good or bad, there is a class composed of those which are indifferent, and which may be preferred to each other on incidental but not on moral grounds. The great struggle of stoical morality is to subdue all emotion, which is in itself contrary to nature, entirely without utility, and productive only of evil. Emotions arise from a failure to form a right practical judgment between what is good and evil. The man who subdues his passions is king and lord, he only is free, and is possessed of all moral perfection. The sage, though without passion, is not without feeling; virtue does not make him insensible to pain and privation, but it makes him superior to it. Virtue is thus sufficient for happiness. No act is virtuous or vicious in itself, but only in its motive. The sage is he who does right actions from right motives. Pleasure is a result of action, but not the end of it. The cardinal virtues are wisdom, courage, justice, and discretion. Every act of the sage combines them all. According to some of the Stoics he who has once attained to virtue cannot fall from it. In virtue there are no degrees. It is absolute, and there is no mean between it and vice. Any action which is not perfectly virtuous is as unvirtuous as the most vicious action. Yet Zeno and most of the later Stoics admitted that there is no perfect sage, and that men are distinguished into two classes only, those who are approximating to virtue and fools. The sage is master of his own life, and may lawfully put an end to it. Although sufficient in himself, and needing nothing for his own happiness, the sage is a member of a community which includes all rational beings. He may take an active part in the affairs of the state, especially when the government is founded on

right principles. He is just, not indulgent, towards himself and others.

Stoicism is accused of fostering pride and self-sufficiency, and of substituting for true virtue a hollow magnanimity based on an undistinguishing hostility to all passions whether lawful or unlawful, laudable or blamable. It is likewise charged with making a distinction between passions, admitting those of the body as necessary and therefore indifferent, and prohibiting those of the mind as hostile to human liberty and perfectibility, thus opening a door for the encouraging the basest of passions, and covering an epicurean license with an affectation of impassibility. These are the defects and abuses of the system, and must not be held as practically chargeable against the better class of Stoics, who have afforded some of the most conspicuous examples of public virtue in ancient and particularly in Roman history. Among the purest moralists of the stoical school were its latest moralists, Epictetus and Marcus Aurelius.

STOKE-UPON-TRENT, a municipal and parliamentary borough of England, in Staffordshire, 14 miles north-west of Stafford. The parliamentary borough formerly included about two-thirds of the populous district of the Potteries, but the redistribution scheme of 1885 disjoined Hanley, Burslem, and those parts which lie to the north of Hanley, and erected them into a separate parliamentary borough. The town, situated on the Trent and Mersey Canal and the Cauldon Canal, has recently undergone great improvements, and may now be considered well-built. It has a handsome parish church, in Early English style, an elegant town-hall, free library and museum, school of science and art, market-hall, public baths, the North Staffordshire infirmary, steam tramways; extensive manufactures of china and earthenware, encaustic tiles and tessellated pavements; and there are blast-furnaces, engine and machine works, &c. The borough sends one member to Parliament. Pop. (1891), of mun. bor., 24,027; of parl. bor., 75,352; (1901), 30,456 and 89,023.

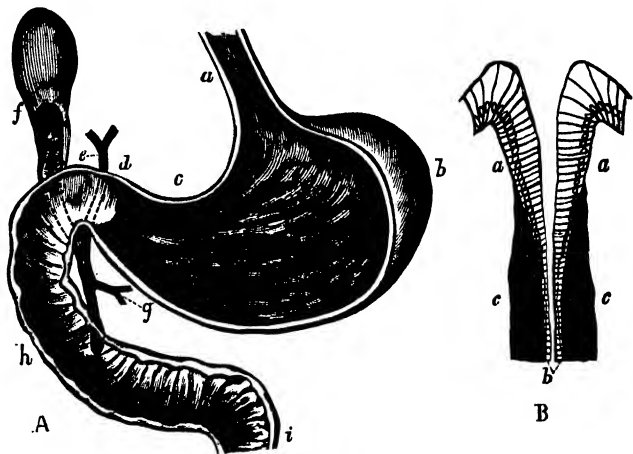
STOLE (ecclesiastical), a long narrow band or scarf with fringed ends, worn by ecclesiastics of the Roman and English Churches, by deacons over the left shoulder, being fastened under the right arm; by bishops round the neck with both ends pendent in front to the knees; and by priests similarly, but with the ends crossed over the breast at mass.

STOLE, GROOM OF THE, an officer of the British royal household under the lord-chamberlain. He is first lord of the bed-chamber.

STOLP, or STOLPE, a town of Prussia, in the province of Pomerania, on the navigable Stolpe, 38 miles north-east of Köslin. It has an old castle, two fine churches, and others of less interest, several schools, &c. Amber-turning and linen-weaving are the chief industries. Pop. (1885), 22,442; (1900), 27,272.

STOMACH, the name given to the sac or cavity

forming a typical subdivision of the digestive system of animals, in which the food undergoes the primary changes in the course of its conversion into nutritive matter. All animals do not possess a stomach-sac. In no Protozoön, for example, is a stomach-sac developed, the process of digestion being subserved by the general protoplasm or sarcodæ of which the bodies of these lowest animals are composed. In the succeeding and higher sub-kingdom of animals, that of the Coelenterata, a stomach is specialized in the higher group alone—this group being represented by the Actinozoa (Sea-anemones, Corals, &c.). In this group, however, the stomach is of imperfect structure, in that it is open inferiorly, and communicates freely with the general (or *somatic*) body-cavity. In the Hydrozoa, such as the Hydrea, Zoophytes, Jelly-fishes, &c., a true stomach is not developed,



STOMACH OF MAN.—A, Stomach opened, showing the internal longitudinal folds or *rugae*: the cardiac or oesophageal end with the gullet at *a*; the cardiac dilatation at *b*; the lesser curvature at *c*; the pyloric extremity at *d*; the bile-duct at *e*; the gall-bladder *f*; the pancreatic duct (*g*) joining the common bile-duct, which latter enters the intestine opposite *h*; and the duodenum (*h* & *i*) or first part of the intestine, continued from the pyloric end of the stomach. B, Part of one of the gastric glands (magnified), showing at *a* the columnar epithelial cells lining the upper part of the tubular gland; at *b* the smaller cells into which these are continued below; and at *c* the true gastric or glandular cells which secrete the gastric juice.

the functions of the digestive sac being performed by the general body-cavity, which is destitute of any organs or viscera. And when we come to higher forms still, we may find, as in Tape-worms, animals which live by the imbibition of fluids by the general tissues of their bodies—no distinct stomach being developed; whilst, as in many insects, great modifications may be perceptible in the structural relations of the organ. In man the stomach is a simple organ, not consisting, as in some other Mammals (see RUMINANTS), of various subdivided portions. It forms a great dilatation of the digestive tube, adapted for retaining the food for some time, for thoroughly incorporating it with certain juices or fluids, and for primarily separating from the food certain of the more easily absorbed matters. The human stomach, in anatomical language, is situated partly in the left and right hypochondriac regions, and partly in that known as the epigastric region. It presents a roughly conical shape, the base of the cone being rounded and directed to the left side, whilst it is also curved upon itself. It lies close to the front wall of the abdomen, below the liver and midriff, and above that portion of the intestine (which see)

termed the transverse colon. Its average transverse diameter, when filled, is about 12 inches, whilst its vertical measurement is about 4 inches. It weighs about  $4\frac{1}{2}$  oz. Viewing its greater and left or rounded extremity, or *fundus* (fig. A, b), first, we find this portion to be named the *cardiac* or *splenic* end, the first name having allusion to the entrance near this extremity of the *oesophagus* (a) or gullet; whilst the latter term is given from the proximity to this end of the spleen (which see). This extremity bulges outwards about 2 or 3 inches to the left of the point at which the gullet enters the stomach, and is connected to the spleen by a band of peritoneum (which see) termed the *gastro-splenic omentum*. The gullet enters the stomach by an aperture somewhat funnel-shaped, which is situated in the highest part of the stomach, and is named its *cardiac orifice*. By the opposite aperture, situated at its *pyloric* or lesser extremity (d), the stomach communicates with the *duodenum* (h i), or first portion of the intestinal tube. This aperture is oval, and is guarded by a circular fold of mucous membrane acting as a valve in preventing the contents of the intestine regurgitating backwards into the stomach. The pyloric extremity lies in contact with the front wall of the abdomen, with the under surface of the liver, and with the neck of the gall-bladder. The stomach in its outline exhibits two chief curvatures, described by anatomists. The *lesser curvature* (c) forms the upper boundary of the stomach, and extends between the opening of the *oesophagus* and that of the pylorus. By this surface the stomach is connected to the under surface of the liver by the lesser omentum. The *greater curvature* describes the inferior boundary of the stomach, and from this latter portion the greater omentum already alluded to originates. The stomach, through its posterior surface, comes into relation with the sweetbread or pancreas, with the chief blood-vessels of the abdomen, and with the pillars or *crura* of the midriff or diaphragm. Of the parts which are most movable in the stomach the pyloric end and greater curvature form the most mobile surfaces. The stomach during life undergoes certain functional and constant changes in position; as in *inspiration*, for example, when it is forced downwards by the descent of the midriff; or, as when *distended*, the midriff is forced upwards, and the cavity of the chest is therefore contracted, whilst the heart may also be pushed upwards—these changes giving rise to the difficulty in breathing and to the palpitation complained of in cases of over-distention of the stomach and in indigestion. In *tight-lacing* the stomach is pressed downwards upon other organs, whilst when the organ is *empty* the chest-floor is brought into intimate contact with it by the descent of the diaphragm. The intimate structure of the stomach becomes interesting to note from its relations to the functions the organ has to perform. It has not only to contain the food, but to act upon it by its specially secreted fluid, the *gastric juice*; and hence the stomach may be viewed as not merely a cavity for the reception of food, but as an actual secreting organ. It is composed of four layers or coats. Externally we find a *serous* coat, which forms part of the peritoneum (which see) or lining membrane of the abdomen. It invests the entire organ, save along the curvatures, at the point of contact of the greater and lesser omenta, at which point the nerves and vessels of the stomach, to be hereafter noted, enter the organ. The *muscular coat* consists of outer longitudinal fibres; of circular fibres, which are uniformly distributed over its entire surface; and of oblique fibres, found chiefly at the *cardiac* extremity of the stomach. The *cellular* or third coat of the stomach is loosely connected to the other coats, and exists chiefly as a support to the blood-

vessels which nourish the inner or *mucous coat*; from this latter reason the cellular layer sometimes receives the name of *vascular* or *submucous* coat. The mucous layer forming the inner surface of the organ is very thick, and presents a smooth soft surface. It is pink-coloured in early life, but yellowish or ashy-gray in the adult. It is thickest at the pyloric end, and when the stomach is empty or contracted is thrown into numerous characteristic plaits or folds named *rugæ*, which in the distended state of the organ are obliterated. Within the mucous membrane the characteristic *glandular* structures of the stomach are seen. It exhibits a honey-combed appearance from the presence of rounded or hexagonal spaces or areas (*alveoli*) varying from  $\frac{1}{10}$ th to  $\frac{1}{15}$ th of an inch in diameter. These areas are separated from each other by ridges, and at the bottom of them the minute openings of the so-called *tubular glands* or *gastric follicles* are seen. These form the chief glands of the stomach, and at the cardiac end evince a simple tubular structure, whilst at the pyloric extremity they become of more complicated aspect, and are more thickly aggregated together, terminating in sac-like extremities which show a subdivision each into six or eight tubular branches. Each tubular gland or follicle (see fig. B) is about  $\frac{1}{10}$ th inch in length and  $\frac{1}{15}$ th in diameter, and is composed of a *basement membrane* lined by *cells* of the *columnar epithelial* kind; whilst this epithelial lining may evince different characters in different parts of its extent in each tube. A minute central space is left in each follicle, and into this space the fluids manufactured by the epithelial cells are excreted. Other glands, named *lenticular glands*, also exist in the stomach. These latter are small closed sacs, and are found chiefly at its pyloric end. They are most plentiful in children, and resemble the *solitary glands* of the intestine. The stomach derives its blood-vessels from the *hepatic* and *splenic* arteries, and its nerves from the *right* and *left pneumogastric* trunks. The *veins* terminate in the *splenic* and *portal veins*.

The *functions* of the stomach include the consideration of the composition and properties of the *gastric juice*—its characteristic secretion (see GASTRIC JUICE). The following table gives this composition, with comparative analysis of that of man, of the sheep and dog:—

	MAN.		SHEEP.		DOG.
Water, .....	994.40	..	986.14	..	971.17
Solids, .....	5.59	..	13.85	..	28.82
Ferment-pepsin (with Ammonia traces), ..	8.19	..	4.20	..	17.50
Hydrochloric acid, ....	0.20	..	1.55	..	2.70
Chloride of lime, ....	0.03	..	0.11	..	1.66
" sodium, ....	1.43	..	4.36	..	8.14
" potass, ....	0.55	..	1.51	..	1.07
Phosphates of lime, } magnesia, and iron, }	0.12	..	2.09	..	2.73

The *quantity* of gastric juice secreted in man has been estimated at from 10 to 20 pints in the twenty-four hours. Its chief constituents are *pepsin*, a nitrogenous substance, and a free *acid*,—disputes having occurred among physiologists as to whether this latter is *hydrochloric* or *lactic acid*. The effect of the gastric juice coming in contact with the food is to change the food into *chyme*—a substance varying in composition relatively to the food, but having a strong acid taste and smell. The gastric juice acts exclusively on proteid or albuminous food-stuffs. Such substances are insoluble; are incapable of passing through an animal membrane, and therefore cannot enter the circulation. But the gastric juice converts them into peptones, which are soluble and capable of passing through membranes, thus becoming fit to be absorbed into the blood. The conditions

favouring the perfect chymification of food in the stomach are, firstly, a small state of division of the food-particles, rendering them easily acted upon by the fluids of the stomach. Hence the importance of perfectly masticating or chewing the food. Liquid foods are readily soluble in the secretions of the stomach, and may be at once absorbed into the current of the circulation by the blood-vessels of the stomach. The action of the stomach upon foods has been investigated in cases of *gastric fistula*, or those in which, from accident or disease, the internal cavity of the organ has been placed in direct communication with the external world; and in the subjects of which, accordingly, the process of digestion could be watched and studied at will. One of the best known cases of this kind was that of Alexis St. Martin, a young Canadian, who was wounded in the abdomen by the accidental discharge of a gun; a fistulous opening resulted from the wound, through which the movements and other details in the action of the stomach could be watched and noted. Dr. Beaumont made many interesting observations in St. Martin's case, and showed, for example, that in health digestion in the stomach is a process of so rapid a nature that a substantial meal of animal and vegetable food may be converted into chyme in about an hour; the stomach being completely emptied in two and a half hours. Thus St. Martin breakfasted at 8 A.M. on one occasion, on coffee, pancakes, and three hard-boiled eggs. At 8.30 slight digestion had begun, the foods being mixed, and at 10.15 digestion in the stomach had been fully completed, no traces of the meal remaining. The circumstances which affect this digestion consist, of course, in the quantity and nature of food taken; in the good health of the subject of observation; in the moderate distension of the organ; in its being empty at the ingestion of fresh nutriment; in *gentle* exercise being taken after the meal—violent exertion being as prejudicial to good digestion as utter want of exercise; whilst the mind must also be in a tranquil condition. From three to four hours may be accepted as a good average period required for the digestion of food in the stomach. In St. Martin's case Dr. Beaumont showed that rice and tripe were converted into chyme in about one hour; eggs, salmon, apples, and venison required one and a half hours; tapioca, barley milk, fish, and liver two hours; turkey, lamb, potatoes, and pork two and a half hours; beef and mutton and fowl three to three and a half hours; and veal, rather longer than beef or mutton. Vegetable matters required on the whole longer time for their digestion than animal foods. In the digestion of flesh it has been found that the muscles break gradually down into their component parts or ultimate fasciculi (see *MUSCLE*), these again being slowly digested, until nothing remains but the muscle-sheath or *sarcolemma*, which is the last to disappear. In the discharge of its functions it is interesting to note that the stomach, like the intestines (which see), assists digestion by the performance of certain well-defined *movements*, which are well calculated to mix and thoroughly combine the food-particles with its contained fluids. These movements also adapt the stomach in its form and capacity to the contained quantity of food; whilst by muscular contraction the orifices of the organ are kept in apposition until the proper period arrives for the discharge of its contents. When empty, the stomach exists in a contracted condition, the cardiac opening remaining closed except during the passage of food. The movements become more and more defined as digestion or chymification proceeds; and it is noteworthy, as regards the direction of the movements, that a kind of double circulation of the contents of the stomach appears to be carried

out, the outermost particles of food being gradually sent towards the pylorus, and the central parts of the digesting mass being propelled in the direction of the cardiac orifice. The *rationale* of the movements of the stomach in the act of *vomiting* have been disputed by physiologists; but it appears tolerably clear that, whilst the spasmodic contraction of the abdominal muscles accomplishes much of that act, the stomach is by no means merely passive, as some authorities have maintained. It may also be interesting to note that some persons acquire a habit of vomiting at will, whilst others have the power of returning the food to the mouth from the stomach, and of subjecting it to a secondary mastication—as in the act of rumination (which see). The influence of the *nervous system* on the functions of the stomach is of a very marked kind. The actions or state of the stomach alone do not suffice for the production or alleviation of hunger, since, when the nerves of the organ are divided, the sensations of hunger are not allayed. It is probable that the system generally, including the stomach, participates in the production of these sensations. Division of the nerves of the stomach may stop the secretion of the gastric juice, but may not permanently affect its manufacture. Sometimes, as after sudden death, when the stomach has been engaged in the process of digestion, its walls may themselves be digested by the gastric juice. It is probable that this phenomenon of *post-mortem digestion* is due, in part at least, to the sudden withdrawal of the active living nervous power; whilst chemical changes produced by death, in the organ itself and in the blood, may suffice to explain the curious fact of the stomach digesting itself—a fact not without due significance in cases of alleged poisoning and perforation of the stomach.

The structure of the stomach in lower animals affords a study for the systematic zoologist rather than for the physiologist. Sometimes (as in Worms, many Fishes, &c.) the stomach can hardly be recognized as any dilatation, being almost continuous in its calibre with that of the gullet and intestine. In Birds (see *ORNITHOLOGY*) we meet with a subdivision of the parts, and in Ruminants (which see) this complication is very marked.

The *diseases* to which the stomach is liable comprise *gastritis* or inflammation of the organ; *induration*; *dilatation*—a curious disease, in which the organ becomes enlarged; *ulcer*, leading often to perforation and death; and *cancer*. See also *DYSPEPSIA*.

**STOMACH-PUMP.** A small pump—in this application called the *stomach-pump*—is now successfully employed for the purpose of removing poisons from the stomach in cases where the action of vomiting cannot be excited. It has saved many lives. It resembles the common small syringe, except that there are two apertures near the end, instead of one, which, owing to valves in them, opening different ways, become what are called a *sucking* and a *forcing* passage. When the object is to extract from the stomach, the pump is worked while its sucking orifice is in connection with an elastic tube passed into the stomach; and the discharged matter escapes by the forcing orifice. When it is desired, on the contrary, to throw cleansing water or other liquid into the stomach, the connection of the apertures and the tubes is reversed. As a pump may not be always procurable when the occasion for it arises, the profession should be aware, that a simple tube will, in many cases, answer the purpose as well, if not better. If the tube be introduced, and the body of the patient be so placed that the tube forms a downward channel from the stomach, all fluid matter will escape from the stomach by it, as water escapes from a funnel by its pipe; and if

the outer end of the tube be immersed in liquid, there will be, during the discharge, a siphon action of some force. On changing the posture of the body, water may be poured in through the same tube to wash the stomach. For washing out the stomach a long flexible tube is also in common use, water being run in by means of a funnel attached to one end, and this end being afterwards lowered so as to form the tube into a siphon.

**STOMACH-STAGGERS**, a dangerous disease with horses, which is even yet but little understood. In the stable the horse dozes and rests his head in the manger; he then wakes up and falls to eating, which he continues to do until the distention of the stomach becomes enormous; for the peculiarity of the complaint consists in the total stoppage of digestion, and the uneasy feeling of distention, consequent to such indigestion, appears to deceive the horse, whose morbid excitement induces him to continue eating. This he does until the distention prevents the return of the blood from the head, and the animal dies from apoplexy, or his stomach bursts. When recovery has taken place it has been only in very mild cases. Staggers is treated with oily purgatives and draughts of warm water. From better feeding it is now comparatively rare.

**STOMAPODA**, an interesting order of the class Crustacea, represented by the Locust Shrimps (*Squilla*), the Glass Shrimps (*Erichthys*), Opossum Shrimps (*Mysis*), &c. (See SHRIMP.) As an order the Stomapoda are distinguished by having their eyes supported on foot-stalks. They are therefore Podophthalmate ('stalk-eyed') Crustaceans. From six to eight pairs of legs are developed. The gills when developed are not (as in the Lobsters, &c., or Decapoda) inclosed within a special chamber in the sides of the thorax or chest, but are situated beneath the abdomen, or they may in some cases be attached to the legs borne by the thorax. The carapace or 'shell' is generally of thin, membranous character, and sometimes wholly invests the thorax; but in other Stomapoda again it only covers a few of the segments of the body. The segment of the body which bears the mouth, antennæ, and eyes is always distinctly developed. The mouth is provided with jaws, but only a single pair of maxillipedes or 'foot-jaws' is generally developed. The foot-jaws are succeeded by seven or eight pairs of true feet; the anterior pair being often (as in the Mantis Shrimps) converted into powerful prehensile organs, which, however, unlike the chelæ or nipping-claws of the Lobsters, &c., are never terminated by 'nippers.' The hinder appendages or feet are modified for swimming, and are usually of leaf-like or laminated conformation. As regards their development the Stomapoda appear in their early embryonic stages as free-swimming embryos, to which the name of *Zoës* has been given. Several definite families are included in this order. The *Mysidæ*, or that of the Opossum Shrimps, possess a larger abdomen, a carapace with folded edges, six or eight pairs of thoracic legs, and no thoracic gills. The *Phyllosomidæ* have a flat membranous and transparent carapace, a small abdomen, and seven or eight pairs of thoracic feet. The *Erichthiidae* or Glass Shrimps have also a membranous carapace of transparent kind; whilst the *Squillidæ* possess elongated bodies, with the first pair of thoracic legs largely developed. See also SHRIMP and the plate at CRUSTACEA.

**STONE**, a market town of England, in the county of Stafford, on the left bank of the Trent, 6 miles north of Stafford, with a town-hall, market-hall, two churches, an endowed and other schools, workhouse, &c. Shoes and earthenware are made, and there are two breweries. Pop. (1891), 5754; (1901), 5608.

**STONE**, a common measure of weight. The English imperial standard stone is 14 lbs. avoirdupois. Though this is the only legal weight of this designation, several others are in common use, as 8 lbs. for a stone of butcher meat or fish, 16 lbs. for a stone of cheese, 5 lbs. for a stone of glass, 32 lbs. for a stone of hemp, 15 lbs. (among wool-staplers) for a stone of wool. In Prussia a stone-weight (*Stein*) is the fifth-part of a centner, equal to rather more than 22 lbs. avoirdupois.

**STONE**, or CALCULUS. See CALCULUS.

**STONE**, PRESERVATION OF. The stones of public buildings are liable to decay from two leading causes, the absorption of water charged with carbonic acid gas or other chemical agents, which decompose the lime or argillaceous matter uniting the siliceous substance of the stone, or the mechanical disintegration resulting from the expansion and contraction of the pores charged with moisture. Oils and cements which discolour the stone and require frequently to be renewed have long been used as a means of preservation. Kuklmann introduced the process of silicization, but the silica applied to the stone is liable to be washed out before it is solidified by the atmosphere. Frederick Ransome has patented a process for effecting a chemical process of solidification within the stone. The stone, being first cleaned, is brushed over with a solution of silicate of soda or potash, of a specific gravity suited to the nature of the stone, and afterwards with a solution of chloride of calcium. The lime combines with the silica, forming within the pores of the stone silicate of lime; the chloride at the same time combines with the soda, forming chloride of sodium or common salt, which is removed by an excess of water. The same effect may be produced by other combinations besides those specified. Ransome's process has been tried in London, Glasgow, and other cities. (*Ure's Dictionary of Arts*, &c.)

**STONE-CHAT** (*Pratincola* or *Saxicola rubicola*), a species of Insectorial Birds, belonging to the Dentirostral group of that order, and included in the subfamily of the Erythracinæ or Robins. The genus *Pratincola*, to which the Whin-chat (which see) also belongs, is distinguished by the bill being provided with short bristles; by the rounded opening of the nostrils, which are nearly hidden by the plumes of the forehead; by the wings being of long and rounded conformation, and possessing their fourth and fifth quills longer than the others; and by the tail being long and of forked shape. The toes are short and of slender make. The Stone-chat is a familiar little bird, averaging about 5 inches in length, and which forms one of the permanent British birds. Its colour is black on the throat, chin, and upper parts generally; the upper wing-coverts being white, as also are the sides of the neck and the upper coverts of the tail. The breast is of a chestnut-brown hue, the belly being of a yellowish-white colour. The other wing-coverts are brown, the wing-quills being also of the latter colour. The name of this bird is derived from its noisy chattering habits. It is bold, lively, and wary, and its song is sweet. It seems to prefer the neighbourhood of furze-thickets, and feeds on the worms and insects which it procures in these localities. The nest is formed of grasses and moss, and the eggs, numbering from four to six, are coloured of a pale blue, spotted at one end with reddish-brown markings.

**STONE-CRAB** (*Liathodes Maia*), a species of Crustaceans belonging to the order Decapoda, and to the same section (*Anomura*) of that order as that to which the familiar Hermit-crabs belong. The genus *Liathodes* also includes the Japanese Porcupine Crab, so named from its spiny shell or carapace. In the

Stone-crabs the same spinous condition of the shell is seen, the rostrum or beak of the carapace being very long. The hind legs are contained within the gill or branchial chambers, and the inner antennæ or feelers are elongated. The Stone-crabs are very common denizens of both English and Scotch coasts. It is not unlike the Spider Crab (which see) in appearance, but the latter belongs to the Brachyura, a section of the Decapoda, embracing the true crabs. The Stone-crab has the beak of the shell furnished with two tooth-like processes. It is of a bright scarlet colour when first taken out of the water. These crabs appear to form a considerable part of the food of the larger fishes, such as cod, &c., specimens being often found entire within their bodies.

**STONE-FLY** (*Pera bicaudata*), a well-known species of Neuropterous Insects (see NEUROPTERA), much used as a bait in trout-fishing by anglers. These flies belong to the family Perlidae, which is in turn included in the section Biomorphotica of the above order. The family is recognized by the hinder wings being of large size, and folded, whilst the tarsi are three-jointed, and the antennæ or feelers are filamentary in nature. The abdomen is provided with a pair of long-jointed caudal appendages—the presence of these latter, which are also developed in the larvæ, giving rise to the specific name *bicaudata*. The mandibles or large jaws are rudimentary. These flies and their larvæ occur plentifully in the neighbourhood of lakes and ponds. They are carnivorous in habits, and the larvæ are aquatic, and breathe by means of gill-filaments borne on the thorax or abdomen.

**STONEHAVEN**, a seaport of Scotland, the county town of Kincardine, 15 miles south by west of Aberdeen, on a bay of the German Ocean at the mouths of the Carron and Cowie. It consists of an irregular old town on the right, and a well-built new town on the left bank of the Carron; and has a handsome market-house, several churches, a courthouse, &c. There are large tanworks and a woollen mill in the town and an extensive distillery in the neighbourhood. Herring and other fisheries are carried on to a considerable extent. It is a favourite summer resort. Pop. (1891), 4497; (1901), 4565. Two miles south is the castle of Dunnottar (which see).

**STONEHENGE**, an extensive group of gigantic standing stones in Salisbury Plain, Wiltshire, which forms one of the most remarkable antiquities of Great Britain. Seen from a distance on the plain, Stonehenge does not present a very striking appearance, and when observed more closely some time is needed to discover a plan in the confused remains, which are then found to represent a work of great magnitude, but of which the origin and design still remain obscure. The plain is covered with those ancient sepulchral mounds called barrows, containing British and some Roman remains. Stonehenge itself is inclosed in a double mound, with a shallow ditch of circular form, and there is an avenue leading from the north-east, bounded on each side by a similar mound and ditch. The outer mound is 15 feet high, the ditch nearly 30 feet broad, and the avenue is 594 yards long. The whole work consists of two circles and two ovals. The outer circle, which is 108 feet in diameter, consisted, when entire, of sixty stones, thirty uprights, and thirty imposts, the uprights being placed at intervals of 3½ feet, and the imposts fitting in to them continuously, each upright stone having a tenon at each side into which fits a mortice in one of the superincumbent stones. The stones of the outer circle are about 14 feet high and 7 broad. Of the outer circle remain twenty-four uprights, seventeen standing and seven down, and eight imposts, and at the grand entrance there are eleven

uprights remaining, with five imposts. The space between the outer and inner circles is 8 feet, and the walk between them is 800 feet in circumference. The inner circle consisted of about thirty stones, 6 feet in height, without imposts; nineteen remain, eleven standing. The first oval consists of five trilithons, as they are called, that is, groups of three stones, two uprights, with an impost completely covering their upper edges. These groups are thus independent and not continuous like the circles. Before each trilithon stood three smaller upright stones. The height of the trilithons ranges from 16 to 22 feet. The height of the smaller stones in the interior of the trilithons is about 7 feet. Only six of them remain standing. The space within this inner oval is called the *adytum*. At its upper end, and in front of the principal trilithon, is a large slab of coarse blue marble, 16 feet long, 4 feet broad, and 20 inches thick, which is called the altar. It has been conjectured, from the grain and appearance of the stones, that they have been brought from Marlborough Downs, 15 or 16 miles off.

About a mile and a half north-east of Stonehenge there is a flat tract of land bounded by parallel banks and ditches, called the *Curus*. It is nearly 1½ mile long, and 110 yards broad. A mound stretches across its eastern extremity. The *Curus* bears a resemblance to a Roman circus, and was probably an imitation of one formed for a similar purpose.

Much conjecture has been expended on the origin and purpose of the structure named Stonehenge, but little light has been thrown upon the subject. From the art used in the construction, as well as from Roman remains found within the inclosure, it seems probable that it was not erected before the period of Roman ascendancy. It has, indeed, been conjectured that the outer circle was erected at a later period than the rest, but besides that the two ovals seem to bear the same relation to each other as the two circles, it seems difficult to supply a motive for such an addition at a different time and in altered circumstances from those in which the original work was erected. The common notion is that Stonehenge is a Druidical temple, but that this and similar structures have any connection with the Druids there is no evidence. It is similar to the remains at Avebury, in the same district (see AVEBURY). The Rev. E. Duke, in *Druidical Temples of the County of Wilts*, propounded a theory that Stonehenge was a temple of Saturn. A. Herbert, in his *Cyclops Christianus*, supposes that Stonehenge is an erection of the fifth century, by a Neo-Druidic sect, who blended Christian forms with heathen rites. Mr. Fergusson supposes the stones at Stonehenge to have been monuments or stones of victory erected between A.D. 400 and A.D. 900.

Sir John Lubbock (Lord Avebury—see Pre-historic Times, 4th ed.) considers there is evidence to show that Stonehenge belongs to the Bronze Age, and believes that both it and Avebury were used as temples of some old-world religion. 'It is evident,' he says, 'that Stonehenge was at one time a spot of great sanctity. A glance at the Ordnance map will show that tumuli cluster in great numbers round and within sight of it. Within a radius of three miles there are about three hundred burial mounds, while the rest of the country is comparatively free from them. If, then, we could determine the date of these tumuli, we should be justified, I think, in referring the Great Temple itself to the same period. Now, of these barrows, Sir Richard Colt Hoare examined a great number, 151 of which had not been previously opened. Of these the great majority contained interments by cremation, in the manner

usual during the Bronze Age. Only two contained any iron weapons, and these were both secondary interments; that is to say, the owners of the iron weapons were not the original occupiers of the tumuli. Of the other burial mounds no less than 39 contained objects of bronze. . . . Stonehenge then may, I think, be regarded as a monument of the Bronze Age, though apparently it was not all erected at one time, the inner circle of small, unwrought blue stones being probably older than the rest.

STONES, PRECIOUS. See GEMS.

STONEWARE. See POTTERY.

STONINGTON, a town and port of entry of the United States, in New London County, Connecticut, on Long Island Sound, 53 miles east of New Haven. It has an excellent harbour, protected by a breakwater, and there is daily steamboat communication with New York. There are manufactures of silk and cotton machinery, cotton and woollen goods, velvet, boilers, iron and brass goods, &c. It has some vessels engaged in the fisheries. Pop. (1890), 7184.

STOOL OF REPENTANCE. See CUTTY-STOOL.

STOP, a word applied by violin and violoncello performers to that pressure of the strings by which they are brought into contact with the finger-board, and by which the pitch of the note is determined. Hence a string, when so pressed, is said to be *stopped*. —*Stop of an organ*, a collection of pipes similar in tone and quality, which run through the whole, or a great part, of the compass of the instrument, and are so arranged that by means of registers the air proceeding from the bellows may be admitted or excluded at pleasure. See ORGAN.

STOPPAGE IN TRANSITU is the exercise of a right allowed by law to a seller to stop the delivery of goods purchased by a buyer who has become bankrupt while the goods are in the hands of a carrier or middle-man for transmission. The laws of England and Scotland are nearly alike in regard to stoppage *in transitu*, but in Scotland the mere fact of bankruptcy is held to act presumptively as a countermand of a previous order, while in England it is no bar to the completion of the purchase unless some actual step to that effect be taken by the seller. It is not necessary that the vendee should have been judicially declared bankrupt or insolvent; mere inability to pay his debts as they become due constitutes the insolvency contemplated by the law. Of course the burden of proof rests on the seller to establish the fact of insolvency or bankruptcy in case it is denied. Stoppage *in transitu* is not held to cancel the transaction, but only to place the goods under lien of the seller for the price. The *transitus*, during which goods are liable to stoppage, is terminated by actual or constructive delivery to the buyer or his agent. A common carrier is not considered the agent of the buyer, although employed by him for the transmission of the goods; but if goods are delivered at a shipping port to a buyer's agent for trans-shipment, the *transitus* is at an end and cannot be renewed when they are redelivered to a common carrier. Although the buyer is the charterer for the voyage of the ship in which the goods are carried they are not held to be delivered to him until the delivery is completed in the usual manner at the close of the voyage; but if he has hired the ship for a period it will be considered as his premises and the delivery will be complete. The law of the United States in relation to this subject is virtually the same as that of England.

STORAX, a solid resin resembling benzoin, formerly obtained from a small tree or shrub of Asia Minor, known to botanists as *Styrax officinalis*. Storax was known in ancient times and was in use till about the end of the eighteenth century, but,

owing to the practical disappearance of the trees it is no longer an article of commerce. *Liquid storax*, or storax balsam, is a nearly-related body which was also known in ancient times, and is still in use. It is made by boiling the inner bark of the Oriental sweet-gum tree or liquidambar (*Liquidambar orientalis*) in water. It is, in its ordinary form, a grayish-brown, semi-liquid substance of about the consistence of honey, but when thoroughly freed from water it is perfectly transparent. The odour is very agreeable. Besides various impurities, storax balsam contains several organic substances of complicated composition, such as styrolene, cinnamic acid, and styracin. Turpentine is a common adulterant. In medicine it is used for the same purposes as balsam of Peru. With olive-oil it forms an ointment of great value in cases of itch, and it is used internally in chronic colds. The compound tincture of benzoin, or friars' balsam, contains storax. It has long been used in making incense and fumigating preparations, and it also enters into perfumery. *Altingia excelsa*, a tree of Burma, yields a similar balsam known as *rose-maloe*, and the *Liquidambar formosana* of Formosa and southern China also produces a substance of like properties. An American species of the storax genus (*L. styraciflua*) yields a balsam used for similar purposes and also in the manufacture of chewing-gum.

STORK (*Ciconia*), a genus of Grallatorial or Wading Birds, distinguished as a sub-family (*Ciconiinae*) by the long compressed bill, by the narrow nostrils pierced through the beak, by the large wings and moderate-sized tail, and by the long tarsi, the front toes being united at their bases. The genus *Ciconia* itself is marked, in addition to the above characters, by the bill possessing a prominent, straight ridge or keel; by the third and fourth quills being the longest of the wings, by the hind toe being raised but still touching the ground, and by the tarsi having network-like scales in front. The Common or White Stork (*C. alba*, see ORNITHOLOGY, Pl. VI., fig. 9) is a bird of a pure white colour, the wing-quills, shoulder feathers, and greater wing-coverts being black. The eyes are surrounded by black skin, the eyes themselves being brown, and the beak and toes red. The average length is about 3½ feet, the head when erect being about 4 feet high. These birds were formerly common in England, but are now chiefly found on many parts of the Continent, where they breed, migrating southwards to Africa in winter. In Holland and in many parts of Germany these birds are treated with great kindness and consideration, building their nests on the tops of houses, and otherwise showing the most perfect confidence in their human surroundings. They live on frogs, reptiles, snails, worms, offal, &c., and render some service to man in return for his protection, by removing garbage which otherwise would become offensive. The nest is formed of sticks, grasses, reeds, &c., and is generally erected in some high situation, such as a spire, or pillar, or chimney. The young number three or four, and remain long under the care of their parents, which are exceedingly devoted to their young. The flight is very powerful, and during migration these birds appear to fly in immense flocks, guided by regular leaders. In their resting posture these birds stand on one leg, the neck being doubled back, and the head being buried in the shoulder. The storks come to Europe in the spring, leaving for the south of Asia and Africa in October. Several very remarkable anecdotes are related of the attachment of these birds to their young, as also of their general intelligence and sagacity. At the conflagration of Delft a female stork was seen to perish in the flames rather than leave her nest, and after repeated

attempts to save her young. A pair of storks which for years had paired and bred had their nuptial felicity marred by the advances to the female of a younger male. At first the female repulsed the suitor, but at length admitted him to the nest, and both in concert then attacked the old male and killed him with their sharp bills. The Black Stork (*Ciconia nigra*) is a second well-known species, differing from the Common White Stork chiefly in the general black colour of the plumage. In habits the Black Stork closely resembles the white species. The gigantic stork, or Adjutant of Bengal (*Leptoptilos argala*), is a celebrated bird, very common about the mouths of the Ganges, and even in the streets of Calcutta, where it is protected by law, as also in other parts of the East Indies. (See ADJUTANT BIRD.) A second genus (*Baleniceps*) of Storks is included in the family Ciconiinae, this genus being represented by the Whale-headed Stork (*B. rex*), a bird inhabiting equatorial Africa and the banks of the Nile, and distinguished by the large bill, which has its sides greatly expanded, the keel or ridge wide and flat, with two grooves, whilst its edges overhang the lower mandible, and the tip of the bill being very deeply scooped and hooked. The nostrils exist at the base of the groove. The toes are long and straight. This curious bird, sometimes also known as the *Shoe-bird*, derives its popular names from the large and curious conformation of its bill. The beak is of a brown colour, marked with darker hues, whilst the plumage is coloured dark gray above and lighter gray beneath; the feathers being variously marked with hues of the same colour. The under parts are of a lighter gray colour. They inhabit marshy spots, and appear to be gregarious; their food consisting of fishes, water-snakes, &c. They breed in the rainy season, during July and August, the eggs being deposited in a hole in the earth.

**STORM.** See WINDS.

**STORM-GLASS**, a kind of weather-glass sometimes called the chemical weather-glass. Take 2½ drachms of camphor, 38 grains of nitre, and 38 grains of sal-ammoniac; dissolve in 9 drachms of water and 11 drachms of rectified spirit with a gentle heat; put the mixture into a long glass tube, which is then closed at the end except a small hole left to admit air. The appearances presented by the contents of such a tube are supposed to give indication of the coming weather.

**STORNOWAY**, a police burgh and seaport of Scotland, the largest town in the county of Ross and Cromarty, on the east coast of the Island of Lewis. It occupies a peninsula formed by two branches of the harbour, and is generally well built. It has spacious and elegant assembly-rooms, with a handsome reading-room, and a public library, a volunteer drill-hall, a naval reserve battery, &c. The quays and wharves are well adapted for the loading and unloading of vessels. There is a neat custom-house and a building yard with patent slip for repairing vessels. The principal trade is in herrings and white-fish. Pop. in 1891, 3386; in 1901, 3711.

**STORTHING**, the Norwegian Diet. See NORWAY.

**STOTHARD, THOMAS**, an eminent English painter, was the son of a publican, and was born in his father's house, the Black Horse, in Long Acre, 17th August, 1755. He very early exhibited a taste for drawing. At eight years of age he was placed at school at Stretton, near Tadcaster, where he remained till his thirteenth year, when he was removed to a boarding-school at Ilford, Essex. On his father's death, about a year after, he was bound apprentice to a drawer of patterns for brocaded silks in London. His apprenticeship was cut short in conse-

quence of the decline of the trade. He afterwards drew designs for the Novelist's and Poetical magazines, published by Harrison, Paternoster Row, and for Bell's British Poets. His success in this line, particularly in the latter works, brought him into great demand, and he was extensively employed as a book illustrator. In 1777 he became a student at the Royal Academy, and in the following year he exhibited as his first picture there *The Holy Family*. In 1791 he was elected an associate of the Academy, and in 1794 he became an Academician. In 1810 he was appointed deputy librarian, and in 1812 succeeded Mr. Birch as librarian. Among his works may be mentioned his designs for novels by Richardson, Fielding, and Smollett; for Sterne's *Tristram Shandy*; for Milton's works; for Rogers's *Poems and Italy*; some historical pictures, and his *Canterbury Pilgrims*. He painted internal decorations of buildings, and designed silver plate, medals, &c. He is said to have made 5000 designs, 3000 of which were engraved. He died 27th April, 1834. See the *Life* by Mrs. Bray (1851).

**STOURBRIDGE**, a market-town of England, in Worcestershire, pleasantly situated on a gentle declivity, 18 miles north of Worcester. The chief buildings and institutions of the town are: several churches, one of them designed by A. W. Pugin; the town-hall, erected in 1887; the town offices; the old grammar-school, re-organized in 1875; the Bluecoat school; the school of science and art; the institute, containing a library; &c. There are extensive manufactures of glass, iron, and fire-bricks, the last, especially, made of a famous clay, which, from its power of resisting fire, is much in demand, and largely exported. Pop. (1891), 9386; (1901, boundaries extended), 16,302.

**STOVE**, an apparatus of metal, brick, or earthenware, which is heated within by a fire, generally almost excluded from sight. The heating medium may be burning wood, coal, petroleum, or gas. The simplest of all forms is the familiar Dutch stove, a hollow cylinder of iron, standing on the floor, close at top, whence a small flue or chimney proceeds, with bottom bars on which the coals, &c., rest. But as this form was found objectionable from the metal becoming overheated and the air in the apartment becoming unwholesomely dry, many kinds of improved stoves have now taken its place. See VENTILATION and WARMING.

**STOW, JOHN**, an English historian and antiquary, born about 1525 in London. His father, a tailor, brought him up to his own business; but his mind early took a bent towards antiquarian researches, and he ultimately formed the design of writing the annals of English history. For the purpose of examining records, charters, and other documents he travelled on foot to places where they were stored, and purchased old books, manuscripts, and parchments until he had made a valuable collection. His *Summarie of Englyshe Chronicles* was published in 1565, and at various dates up till 1604. The *Chronicles of England from Brute to this Present Yeare*, published in 1580, was re-issued in 1592 under the title *Annals of England*. Edmond Howes issued several editions of it after Stow's death. Stow contributed to the improvement of the second edition of Holinshed in 1587, and gave corrections and notes to two editions of Chaucer. In 1598 appeared his chief work—*Survey of London*—on which he had been long employed, and which came to a second edition during his lifetime. He died on April 6, 1605. Stow's *Survey* was reprinted in 1876 and in 1890.

**STOWE, MRS. HARRIET ELIZABETH BEECHER**, American writer, a daughter of the Rev. Lyman

Beecher, and sister of Henry Ward Beecher, was born at Litchfield, Conn., June 14, 1812. She was educated at Litchfield and then at Hartford, under her sister Catherine, whom she joined in teaching her school there. In 1832 the sisters removed to Cincinnati, Dr. Beecher being appointed president of Lane Theological Seminary there. In 1838 she was married to the Rev. Calvin E. Stowe, a teacher in the seminary, who in 1850 removed to Brunswick, Me., on being appointed a professor in Bowdoin College, soon after exchanging this post for a similar one at Andover. She had become familiar with the evils of slavery during her residence at Cincinnati, and the work by which her name became known throughout the world—Uncle Tom's Cabin—was a direct attack upon slavery, and was (in 1851–52) contributed in serial form to *The National Era*, an anti-slavery newspaper published at Washington. It became almost immediately famous, was translated into many foreign languages, and published in innumerable editions. None of her subsequent works attained anything like the same popularity. They include *Sunny Memories of Foreign Lands*; *Dred*, a Tale of the Great Dismal Swamp; *The Minister's Wooing*; *The Pearl of Orr's Island*; *Agnes of Sorrento*; *Old Town Folks*; &c. From 1864 onwards her home was in Hartford, and here she died, July 1, 1896. She had lost her husband in 1886. See *the Life* by her son (two vols., 1890).

**STOWMARKET**, a market-town in England (and a parl. div.), county of Suffolk, 12 miles N.W. of Ipswich, on the Gipping, which here becomes navigable. There are a corn-exchange, county court-house, beautiful church, mechanics' institute, &c.; manufactures of gun-cotton, malt, bricks, &c.; an iron-foundry, a brewery, and a trade in corn, malt, coal, &c. Pop. (1891), 4339; (1901), 4162.

**STRABANE**, a market-town of Ireland, in Tyrone, finely situated on the river Mourne, and on a canal connecting it with the deeper parts of the Foyle, 15 miles S.W. of Londonderry. The houses are generally well built, and the town has an attractive appearance. The churches comprise two Roman Catholic, one Protestant Episcopal, two Presbyterian, and one Methodist, all of recent date; and the educational institutions comprise a convent school, an academy, &c. There are shirt-factories, saw-mills, corn-mills, coach-factories, and a thriving trade in grain, provisions, flax, &c. Pop. (1881), 4196; (1891), 5013.

**STRABISMUS**. See **SQUINTING**.

**STRABO**, the Greek geographer, was a native of Amasia, in Pontus. The time of his birth is conjectured to have been about B.C. 54, and his death occurred after A.D. 21. He received a good education, and adopted the Stoical Philosophy. He was with Ælius Gallus in Egypt in B.C. 24. He wrote a historical work in forty-three books, which is lost. It formed a continuation of the history of Polybius to the battle of Actium. The extant fragments of it are collected in Müller's *Fragmenta Historicorum Græcorum*. His great work on geography, in seventeen books, has been preserved entire, with the exception of the seventh book, of which there is only an epitome. It includes notices of important political events, and of chief cities and their great men. His language is clear, simple, and appropriate. The first two books contain the introduction, and an account of physical and mathematical geography; the third book begins the descriptive part of the work. Eight books are given to Europe, six to Asia, one to Egypt and Libya. The best critical edition is that by Kramer (Berlin, 1844). See Dubois, *Examen de la Géographie de Strabon* (1892).

**STRADELLA**, ALESSANDRO, born at Naples

about 1645, was chapel-master at Genoa, and composed oratorios, cantatas, madrigals, and operas with great success. At Venice he became enamoured of one of his pupils, the mistress of a Venetian noble, who eloped with him, and proceeded to Rome; but the lady's patron hired two assassins to murder them. They found them in the church of San Giovanni Laterano, and resolved to execute their design in the dusk of the evening as they were retiring from the evening service. In the interval they heard Stradella sing, and were so overpowered that they not only abandoned their design, but informed him of it to put him on his guard. The vindictive patrician, however, was not to be balked of his revenge. Other assassins were hired, and though Stradella was living at the time at Turin under the protection of the Duchess of Savoy, and in her palace, they succeeded in stabbing him in three places. The wounds did not prove mortal, and the duchess, thinking it would prevent further attempts, caused the lovers to be married in her chapel. A final attempt was made at Genoa, and proved successful. The assassins, rushing into their chamber, stabbed both Stradella and his wife to the heart. This tragical story forms the subject of operas by Niedermayer and Flotow, but it is of very doubtful authority, at least in all its details. Stradella probably died about 1681. The largest collection of Stradella's works is at Modena; a number of them are to be found in the library of Christ Church, Oxford, and the British Museum. They are of considerable merit, and are said to have been studied with profit by later composers.

**STRAFFORD**, THOMAS WENTWORTH, first EARL OF, an eminent statesman, was the eldest son of Sir William Wentworth, of an ancient family in Yorkshire. He was born in London on April 13, 1593, and entered at St. John's College, Cambridge. In 1607 he became a student of the Inner Temple, and four years later received the honour of knighthood. He then travelled on the Continent, returning in 1613. The death of his father in 1614 gave him a baronetcy and a large fortune. He was returned for Yorkshire to the Parliament which met this year on 5th April, but it only lasted about two months, and he does not appear to have spoken in it. He was also appointed *custos rotulorum* of Yorkshire, in lieu of Sir John Savile. In 1621 he was again chosen member of Parliament for the county of York; and when James asserted that the Commons enjoyed no rights but by royal permission, Sir Thomas Wentworth, already distinguished for ability, strenuously called upon the House to maintain that their privileges were rights by inheritance. In 1622 he lost his first wife, of the noble family of Clifford, and in 1625 married Arabella, second daughter of Holles, Earl of Clare. On the convening of the new Parliament in the same year he was one of the six popular members who were prevented serving their country in that assembly, by being appointed sheriffs for their respective counties. He submitted to this arbitrary act in silence; and soon after, the Duke of Buckingham, alarmed at the measures taken against him in Parliament, made him overtures, which proved ineffectual, and the favourite revenged himself by obliging him to restore his office of *custos rotulorum* to Sir John Savile. When Charles, among other expedients for raising money, had recourse to a forced general loan, Wentworth refused to pay his contribution, and was first imprisoned in the Marshalsea and then confined to a range of 2 miles round the town of Dartford. This restraint was, however, removed when it became necessary to summon a new Parliament in 1628, and he again took his seat for Yorkshire, and became one of the most conspicuous advocates of the petition of

right. As he had now proved the strength of his abilities, high terms were offered him by the court, which he finally accepted, and in 1628 he was created Baron Wentworth, and some months afterwards a viscount and privy-councillor, and on the resignation of Lord Scrope nominated President of the North. The assassination of Buckingham soon after removed an obstacle to his further promotion, and he became so influential in the king's council that his powers in the four northern counties over which he presided became enormous. The legality of some of the powers of the Council of the North, created by Henry VIII., had been questioned by judges in the reign of Queen Elizabeth, and these powers had been greatly increased at the instance of Wentworth. In the exercise of this authority he displayed equal haughtiness, impetuosity, and ability, and by his strictness in levying exactions increased the revenue in his district to four or five times the previous amount. Having assiduously cultivated the friendship of Archbishop Laud, he was selected by that prelate to proceed to Ireland as lord-deputy in 1632. He greatly improved the state of the country, both as regarded law, revenue, and trade. By a considerable outlay at his own risk he introduced the growth of flax, established looms, brought workmen from France and Flanders to work them, and thus endowed the country with a new and most valuable industry. But, at the same time, nothing could be more arbitrary than his system of government, it being his boast that he had rendered the king as absolute in Ireland 'as any prince in the whole world could be.' On the first symptoms of resistance to the royal authority he counselled the strongest measures, and after the failure of the king's first expedition against Scotland he was sent for from Ireland, and created Earl of Strafford and Knight of the Garter. He returned with the full title of lord-lieutenant, with a view to gain subsidies and troops, in which he fully succeeded; and again repairing to England, took the command in the north, but found himself obliged to retire before the Scottish army, and retreat to York. Charles was now by his necessities obliged to call the long Parliament; on which Strafford, aware of the enmity which he had inspired among the popular leaders, wished to return to his government; but the king, hoping that his great talents would be serviceable, encouraged him by a solemn promise that 'not a hair of his head should be touched by Parliament.' Strafford's apprehensions were well founded. The very first movement of the party opposed to arbitrary power was to impeach him of high treason, with which charge Pym appeared at the bar of the House of Lords in November, 1640. The articles of impeachment, at first nine in number, were afterwards increased to twenty-eight, the object of which was to convict him of an attempt to subvert the fundamental laws of the country. As in the case of Laud, it was easy to prove that he acted as a friend and promoter of arbitrary measures, but not to substantiate any particular fact to justify a capital charge. There can be no doubt, however, that his design was to subvert the fundamental laws and liberties of his country, and to enable the king to rule absolutely and without control. The system by which this was to be effected he, as well as Laud, alluded to in his private correspondence under the term 'thorough.' Although treated with the extreme of legal rigour, and debarred the assistance of counsel, his own great abilities and force of mind supplied every deficiency; 'And never man,' says Whitelock, the chairman of the impeaching committee, 'acted such a part, on such a theatre, with more wisdom, consistency, and eloquence, or with greater reason, judgment, and temper.' His defence, indeed, was so strong that the

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original impeachment was deserted for the unjustifiable proceeding of a bill of attainder. The bill passed the Commons by a great majority, and was carried in the Lords by a feeble one. The king, who had imprudently endeavoured to stop the bill by his personal interference, had not sufficient firmness to redeem the pledge of safety which he had previously given, but yielded to the advice of his counsellors, backed by a letter from Strafford himself, who urged him, for his own safety, to ratify the bill. This act has the semblance of being truly heroic; yet it is probable that he did not think that the king would have been swayed by it, since, being assured of the fatal truth, he lifted his eyes to heaven, and, with his hand on his heart, exclaimed, 'Put not your trust in princes, nor in the sons of men; for in them there is no salvation.' His conduct, from this time to his execution, was in the highest degree composed and noble. At the scaffold he addressed the people, expressing entire resignation to his fate, and asserting the good intention of his actions, however misrepresented. He fell in the forty-ninth year of his age, lamented by some, admired by more, and leaving behind a memorable but certainly not an unspotted name. The Parliament, not long after his death, mitigated his sentence as regarded his children, and in the succeeding reign his attainder was reversed. He married three times, and by his second wife left an only son and several daughters.

**STRAITS SETTLEMENTS.** THE, consist of the British settlements in the Straits of Malacca, namely, Singapore, Penang, and Malacca, with the Cocos Islands and Christmas Island as dependencies, besides several native states now under British protection. (See MALACCA, PENANG, and SINGAPORE.) The government of the Straits Settlements up to 1867 was under the control of the Indian government. They now form a crown colony, and the seat of government is Singapore, Penang and Malacca being each under a resident councillor. The governor is assisted by an executive council of ten official and seven unofficial members, five of whom are nominated by the crown and two elected by the chamber of commerce of Singapore and Penang. The area of the Straits Settlements proper is 1472 square miles; the population in 1891 was 512,342; in 1901, 572,249. The revenue is about £700,000 per annum. The exports are about £24,000,000 in value, and the imports about £28,000,000.

**STRALSUND,** a seaport town of Prussia, capital of the government of Pomerania, on the strait which separates the island of Rügen from the mainland, and so completely surrounded by water as to be approached only by bridges, 120 miles north by west of Berlin. The houses have an old and interesting appearance, and both streets and squares, though irregular and devoid of elegance, are clean and well paved. The principal buildings are the Nicolai Church, a brick structure, begun in 1311, and surmounted by a lofty tower; four other churches, the government-house, the town-house, a turreted edifice, built in 1816; the gymnasium, with a library and cabinet of coins; the mint, arsenal, poorhouse, workhouse, orphan hospital, and infirmary. The manufactures consist of woollens, iron castings, machinery, sugar, cement, cigars, paper, pianos, furniture, playing cards, and there are numerous breweries, distilleries, oil-works, and building docks, in which a great number of vessels are fitted out. The port, though not large, and somewhat encumbered by shallows, is good, and carries on a considerable trade. Stralsund is the seat of a superior court of law and of several public offices. It was founded in 1209 by Prince Jaromar I., of Rügen, and peopled with Saxons. It afterwards became a free imperial and Hanse town, and rose to

great commercial importance. It has repeatedly suffered severely from war. Wallenstein besieged it without success in the Thirty Years' war (1628). In 1678 Frederick William, the great Elector of Brandenburg, took it after a severe bombardment. Pop. (1900), 31,083.

**STRAMONIUM** (*Datura Stramonium*), thorn-apple, a plant of the natural order Atropaceæ. The plants included in this order have been separated from those of the order Solanaceæ, with which they were formerly associated; although in habit, character of their leaves, calyx, ovary, fruit, and seeds they agree essentially; the chief distinctive character between the two orders being the different aestivation of their respective corollas. In addition to *Datura* the genera *Nicotiana*, *Hyoscyamus*, *Atropa*, and others, containing together about 1100 species, are comprised in the order. Many of the plants have powerful narcotic properties, and several are very poisonous. The juice of several species, including the thorn-apple, dilates the pupil of the eye. Stramonium, as the plant is usually called, owes its principal activity to the presence of a narcotic alkaloid named *daturin*, which much resembles *hyoscyamin* and *atropin*, the alkaloids respectively of henbane and the deadly-nightshade. The plant grows in waste places throughout North America, in parts of Europe and of Asia. It has a prismatic calyx, five-toothed, separating above the base in fruit; corolla funnel-shaped, with a large and spreading toothed and plaited border; stigma two-lipped; pod globular, prickly, four-valved, two-celled; seeds rather flat; leaves ovate, sinuate-toothed or angled; stem green; corolla white. All parts of the plant exhale a strong and nauseous odour.

**STRANGE**, SIR ROBERT, descended from an ancient family in the county of Fife, was born in Pomona, one of the Orkney Isles, in 1721. After he had both studied law and attempted a seafaring life, he resolved to devote himself to painting. While thus engaged the rebellion of 1745 broke out, and he immediately joined the forces of the Pretender. As a lieutenant of the life-guards he was present at the battle of Culloden. To conceal himself from pursuit he wandered for some time in the Highlands, and afterwards ventured to Edinburgh, where he subsisted for some time by selling drawings which he had made of the chiefs of the rebellion. He afterwards went to France, gained a prize for design at Rouen, and then resided for some time at Paris, where he studied engraving under the celebrated Le Bas. The knowledge thus acquired he afterwards turned to good account when in 1751 he settled in London and became the founder of the English school of historical engraving. In 1760 he again visited the Continent, and engraved pictures of many of the greatest of the old masters. His fame was now so widely spread that he was admitted member of the academies of Rome, Florence, Bologna, Parma, and Paris, and on his return to England in 1787 he received the honour of knighthood. He died in 1792. His distinguishing characteristics are vigour, clearness, and precision.

**STRANGLES**, a disease incident to young horses, and which they rarely escape. It generally appears between the third and fifth year, and commonly in spring. It is preceded by cough, with a yellowish discharge from the nostril, which is more abundant than in a common cold, and a considerable discharge of ropy fluid from the mouth. This is accompanied by the formation of a tumour under the jaw, beginning about the centre of the channel and gradually filling the whole space. This causes the disease to be sometimes mistaken for glanders, but it is easily distinguished by the circumstance of there being only a single tumour. The tumour gradually swells in

the centre, becoming softer until it bursts, when a discharge of pus takes place. The cough then subsides, and the disease rapidly abates, although a considerable time often elapses before the animal recovers its strength. During the progress of the disease the animal suffers considerably from thirst, which it is unable to satisfy by drinking freely, the attempt to swallow bringing on a convulsive cough, from which the disease has its name.

Treatment is chiefly directed towards advancing the development of the tumour, on the bursting of which convalescence depends. This is most effectively done by blistering or fomentation, by an active employment of which the course of the disease is much shortened and the strength of the animal economized. When the swelling becomes soft on the top it should be freely lanced. When it is allowed to burst naturally an ulcer is formed which is very difficult of treatment. Horses are not liable to strangles a second time.

**STRANRAER**, a royal burgh and seaport of Scotland (till 1885 also a parliamentary burgh), in the county of Wigtown, at the head of Loch Ryan, 20 miles west of Wigtown. The principal buildings are the castle, dating from the 16th century, the town-hall and court-house (opened 1874), the poorhouse, reformatory, two parish churches, besides Free, United Presbyterian, and other churches, an academy, and a number of benevolent societies. Stranraer affords the shortest sea passage between Scotland and the north of Ireland, and has on this account been made a mail packet station, there being daily sailings to and from Larne. A considerable amount of shipping frequents the port. Stranraer is a favourite resort in summer for sea-bathing, and has ample hotel and lodging-house accommodation. It is beautifully situated, and about 3 miles distant are the fine grounds of Castle Kennedy, a seat of the Earl of Stair, which on certain days are open to the public. Pop. (1881), 6415; (1891), 6171; (1901), 6009.

**STRASBURG**, or **STRASSBURG** (French, *Strasbourg*; anciently, *Argentoratum*), a town of Germany and fortress of the first class, in Alsace, the capital of the imperial territory of Alsace-Lorraine, on the Ill, about 2 miles west of the Rhine, 250 miles east by south of Paris. It is of irregular shape, and is divided into several parts by branches of the Ill, the oldest quarter forming an island connected with the others by numerous bridges. It was surrounded by walls and bastions constructed by Vauban, but these have been demolished, and a wider circle of fortifications and forts has been constructed by the Germans since 1871, while the city has correspondingly expanded in various directions. The districts destroyed by the bombardment of 1870 have been rebuilt in modern style. In the older parts the streets are often narrow and crooked; elsewhere they are generally spacious and regular, and many of the public squares are large and handsome. The principal ecclesiastical edifice is the cathedral (dating from the 11th century), one of the noblest Gothic structures in Europe, with a western spire 466 feet high. The west front, which rises to the height of 230 feet, has a triple portal, richly decorated with sculptures, statues, and bas-reliefs, while above this is a circular window 48 feet in diameter. The length of the nave is 357 feet, and the height of the ceiling 79 feet. There are several Protestant churches, one of them a fine new building in the Romanesque style, another a garrison church. There is also a new R. Catholic church, with a large cupola. Other buildings include the Hotel du Commerce, a fine renaissance building of 1582-85; the former episcopal palace, the governor's palace, formerly the prefecture, the town-house, &c. Among buildings

of recent erection must be mentioned the imperial palace, erected in 1888-88 in one of the new quarters of the city; the new and extensive university buildings (inaugurated 1884); the house of assembly for the province; the university and public library; and a great railway station. The university of Strasburg may be said to date from the sixteenth century, but it received an entirely new foundation as the Kaiser Wilhelm's University in 1872. It possesses five faculties, has over 180 teachers, and nearly 1000 students. The library has now 700,000 volumes, and connected with the university are also a botanic garden and an observatory. There are numerous other educational institutions, some for Protestants, others for Catholics. The industries are very varied, embracing tobacco and cigars, beer and spirits, leather, boots and shoes, clothing, furniture, carriages, carpets, machinery, musical and surgical instruments, artificial flowers, gloves, &c. The most famous industry is the making of *pâtés-de-foie-gras*, or goose liver pies, which are said to be exported to the value of £80,000 annually. The trade is very important, and includes, in addition to the above articles of manufacture, wine, corn, tobacco, hops, &c. Strasburg is supposed to have been founded by the Romans, who erected it as a barrier against the incursions of the Germans. The latter, however, ultimately made themselves masters of it, and retained possession till the reign of Clovis, who again drove them back beyond the Rhine. In the sixth century it changed its ancient name of *Argentoratum* for that of Strasburg, and in the beginning of the tenth century became subject to the emperors of Germany. It afterwards acquired great privileges, became a free town, and was governed as a republic. In 1681 it was united to France, and in 1871, after being besieged and captured in 1870, it was ceded with Alsace and Lorraine to Germany. Pop. (1885), 111,980; (1900), 150,268.

**STRATEGY** (from the Greek *strategia*, military command, military skill), the art and science of leading armies, the art of conducting military operations in the field. As a branch of military science it is contradistinguished from tactics, which treats of the mode of handling troops in battle.

**STRATFORD**, a township of England, in Essex, now included in the borough of West Ham, on the east bank of the river Lea, 2½ miles E.N.E. of St. Paul's. The Lea is here crossed by a bridge communicating with Bow. It has a very fine town-hall (enlarged 1886), with a lofty tower; three Established churches, one of them containing a martyrs' memorial; a Roman Catholic church and dissenting chapels; works for the manufacture of candles, varnishes, colours, extensive engineering works in connection with the Great Eastern Railway, chemical works, jute-mills, breweries, distilleries, leather works, &c. Pop. of registration sub-district in 1891, 38,612; in 1901, 44,825.

**STRATFORD-UPON-AVON**, a municipal borough and market-town in Warwickshire, celebrated as being the place where Shakspeare was born and died. It lies 3 miles south-west of Warwick, 94 miles north-west of London, and is beautifully situated on the banks of the Avon, which is here crossed by two bridges, one of them an ancient and handsome stone structure of fourteen pointed arches. It consists of an old and a new town, the former composed for the most part of indifferent houses, and the latter composed generally of spacious and well-formed streets, though, from the improvements which have been made, the distinction between the towns is not easily observed, and many substantial and commodious houses are found in both. The chief objects of interest are the house in which Shakspeare was born

(now the fitting repository of numerous Shaksperian relics), and the parish church in which he was buried. The house in which he died was pulled down in 1759 by a clergyman who bought the place a few years before. The parish church of the Holy Trinity is an ancient, large, and handsome edifice, in the form of a cross, with a square embattled tower terminating in a lofty octagonal spire. The south aisle dates from the time of Edward III., the interior was restored in 1840, and the tower rebuilt with the old material in 1867. Shakspeare's remains were interred in the chancel, which has been recently restored, and here are his monument and bust. On the former are engraved the two lines in Latin:—

'Judicio Pylum, genio Socratem, arte Maronem  
Terra tegit, populus moeret, Olympus habet.'

On the grave-stone beneath are the following lines, attributed to Shakspeare:—

'Good friend, for Jesus' sake, forbear  
To dig the dust inclosed here;  
Blest be the man that spares these stones,  
And curst be he that moves my bones.'

There are several other churches and places of worship, a free grammar and other schools, a plain and substantial town-hall, a guild-hall, the Shakspeare memorial theatre, Shakspeare fountain, library, and picture-gallery. Stratford-on-Avon was a place of considerable consequence previous to the Conquest, and was famous for a monastery, founded in the reign of Ethelred. It suffered severely by fire and a flood in the reign of Elizabeth, and also by the civil war between Charles I. and the parliamentary forces. Pop. in 1891, 8318; in 1901, 8310.

**STRATH**, in Scotland, is generally understood to mean a broad dale or glen, which receives its peculiar appellation from a river passing through it, as Strathbogie, Strathspey, &c.; or some particular characteristic, as Strathmore, the Great Valley, &c., which traverses Scotland on the south side of the Grampian Mountains.

**STRATHAVEN**, a market town and burgh of barony in Scotland in the county of Lanark, 14 miles S.S.E. Glasgow, on a small stream which divides it into two nearly equal parts, and falls into the Avon. In the older quarters of the town the streets are narrow and irregular, and the houses dingy; but in the more modern parts the streets are wide and with well-built houses. The chief employment is the weaving of silk goods, &c.; brewing is also carried on and there is a good general trade. Pop. (1881), 3812; (1891), 3478; (1901), 4076.

**STRATHOLYDE**, a kingdom formed by the Northern Romanized Britons, when the conquests of the Anglo-Saxons had cut them off from the Britons of the South, who were afterwards confined to the principality of Wales. It extended from the Clyde to the Solway, and had its capital in Dumbarton. At a later period the district included in this kingdom was known as Cumbria. There is no authentic history of this British kingdom. It does not even appear to be certain whether the Romanized Britons who formed it were heathen or Christian. The only light thrown on it is from the labours of St. Kentigern or St. Mungo, who flourished about the end of the fifth century, but of whose history the accounts are almost wholly legendary. Towards the close of the separate existence of the Kingdom of Stratholyde its monarchs appear to have entered into alliance and formed marriages with the Scots of the Kingdom of Dalriada. In 1018 the King of Stratholyde appears at the battle of Car, near Wark, in Northumberland, as an ally or tributary of the Scots. Soon after, in the reign of Malcolm II., Stratholyde was absorbed into the Kingdom of Scotland.

**STRATHMORE** is the general name given to the extensive valley or low country which stretches north-east from Ardmore in Dumbartonshire to Stonehaven in Kincardineshire, along the southern side of the Grampians, the mountain rampart of the Highlands, and flanked on the south by the lower ranges of Lennox, Ochil, and Sidlaw. The name is popularly limited to the part of this extensive plain flanked by the Sidlaw Hills, and mostly contained in Forfarshire. The whole of the larger district is, as a rule, remarkable for beauty and fertility, is well peopled, and contains numerous towns.

**STRATUS.** See **CLOUD**.

**STRAUBING**, a town in Lower Bavaria, on the Danube, 22 miles south-east of Ratisbon. It has numerous churches, a castle, once occupied by the dukes of Bavaria and connected with the history of Agnes Bernauer (which see), a fine market-place, a town-house, gymnasium, normal and other schools, hospitals, and breweries. Pop. (1895), 15,595.

**STRAUSS, DAVID FRIEDRICH**, the celebrated theological critic and author of the *Life of Jesus*, was born at Ludwigsburg, in Würtemberg, 27th Jan. 1808, and educated first at the school of his native town, then at the Theological Seminary of Blaubeuren, and at the Theological College of Tübingen. After acting as a parish vicar in 1830, and in 1831 as temporary professor in the seminary of Maulbronn, he resided in Berlin for about six months in order to study the Hegelian philosophy and to hear Schleiermacher. He was next employed as tutor in the Theological College of Tübingen, and held at the same time a philosophical lectureship at the university. In 1835 he became suddenly famous by the publication of his *Leben Jesu*, in which, developing the suggestions of Schelling as to a mythical origin of Christianity, he endeavoured to prove that the entire gospel history was a mythical formation of the first two centuries of the Christian church, founded on the Messianic ideas of the Old Testament. In consequence of this publication, which drew upon him a host of adversaries, he lost his tutorship. He thereupon took a post as teacher in the Lyceum of Ludwigsburg, which he resigned in 1836, and retired into private life in Stuttgart. In 1837 he published, in three volumes, under the title of *Streitschriften*, his replies to his opponents, while in *Zwei friedliche Blätter* (Two Conciliatory Tracts, 1838) he endeavoured to represent his views in their mildest aspect. In 1839 he was called by the educational council of Zürich to the chair of dogmatic theology and church history in the university of that town; but this step raised a storm which was not allayed by the pensioning of the newly-appointed professor, but resulted (8th September) in the overthrow of the government. Thrown back again on literary activity he published his second great work, *Die christliche Glaubenslehre in ihrer geschichtlichen Entwicklung und in ihrem Kampfe mit der modernen Wissenschaft* (The Christian Doctrines in their Historical Development and in their Struggles with Modern Science, 1840–41). In this work he discussed from a new point of view the exegesis, history, and criticism of Christian dogma. The treatise *Über Schleiermacher in his Charakteristiken und Kritiken* (1839) is to be regarded as an introduction to this work. After a long silence he next published in 1847 *Der Romantiker auf dem Throne der Cäsaren, oder Julian der Abtrünnige*, which excited much sensation by its pointed allusions to the reforming career then just inaugurated by Pío IX. In 1848 he became a candidate for the representation of his native town in the German parliament, but the influence of the clerical party with the peasantry proved too strong for his supporters. During the year he published *Sechs theol.-politische*

*Volksreden* (Six Theologico-political Discourses for the People) delivered on this occasion. As a compensation for his defeat his townsmen elected him their representative in the Würtemberg Landtag, but an unexpected leaning to conservative principles which he exhibited drew upon him an indignant remonstrance from his constituents, in consequence of which he resigned his seat in December. He now gave himself entirely to literary and historical labours, and published in rapid succession *Schubart's Leben in seinen Briefen* (two vols. 1849); *Christian Märklin, ein Lebens- und Charakterbild der Gegenwart* (1851); *Leben und Schriften des Dichters und Philologen Nicodemus Frischlin* (1855); *Ulrich von Hutten* (three vols. 1858–60); *Herm. Sam. Reimar's und Seine Schuttschrift für die vernünftigen Verehrer Gottes* (1862); *Kleine Schriften biographischen literar- und Kunstgeschichtlichen Inhalts* (1862). All these works are distinguished by solid investigation and a clear and beautiful style. After the appearance (1863) of Renan's *Vie de Jésus* he published a revised edition of his first work under the title of *Das Leben Jesu für das deutsche Volk bearbeitet* (1864), which, like others of his works, has been translated into several foreign languages. Into the ensuing controversy he entered with *Der Christus des Glaubens und der Jesus der Geschichte* (The Christ of Faith and the Jesus of History, 1865) against Schleiermacher, and *Die Halben und Die Ganzen* (The Half and the Whole) against Schenkel and Hengstenberg. In the same year he published an able discourse on Lessing's *Nathan der Weise*. During a several years' residence at Darmstadt Strauss made the acquaintance of Alice of Hesse, daughter of Queen Victoria, and he published in 1870, with a dedication to her, *Six Discourses on Voltaire*, prepared at her request. On the occasion of the Franco-German war he wrote two letters addressed to Ernest Renan in the *Allgemeine Zeitung*, and published by him along with Renan's replies under the title of *Krieg und Friede* (War and Peace, 1870). In 1871 appeared a revised edition of *Ulrich von Hutten*. A selection of his works, translated by Charles Ritter, with an introduction by E. Renan, appeared in Paris in 1872 under the title of *Essais d'Histoire religieuse et Mélanges littéraires*. In his last great work, produced on the occasion of the strife between the Catholic Church and the German state which followed the war, *Der alte und der neue Glaube. Ein Bekenntniss* (The Old and the New Faith—a Confession, 1872), he endeavoured to represent strongly the irreconcilable opposition between free thought and priestly authority, recognizes the latest results of scientific research as for him the only valid object of belief, explains the world and thought mechanically upon a materialistic basis, and argues against the personality of God on the ground that modern cosmology has left him no heaven to dwell in. Even in this last stage of scepticism Strauss was unable to rid himself of the instinctive feeling of the necessity of a religion, and endeavoured to satisfy this human sentiment by claiming reverence and submission for the laws which govern the universe. In the *Vorwort als Nachwort* (Preface as Conclusion) he shows himself keenly susceptible to the decline of popularity which had resulted from the extreme position taken up in this work. Strauss died 8th February, 1874. An important result of the theological criticism of Strauss was the breaking up of the Hegelian school into three parties, called respectively the right, centre, and left—the ground of the division being the denial of the last party, which followed Strauss, of the consistency of Hegelianism with a belief in the personality of God and the historical character of the Christian religion.

**STRAW, MANUFACTURE OF.** In the manufacture of straw hats the culms of several kinds of grasses are used. The Leghorn straw is the culm of a sort of wheat sown on poor soils, and cut green. Rye straw is much used in this manufacture. After being dried and stacked for a month in a snow, the straw is cut at the joints; and the outer covering being removed it is sorted of equal sizes, and made up into bundles of 8 or 10 inches in length, and 1 foot in circumference. They are then to be dipped in water and shaken a little, so as not to retain too much moisture; the bundles are afterwards to be placed on their edges, for the purpose of bleaching, in a box which is sufficiently close to prevent the escape of smoke. In the middle of the box is an earthen dish containing brimstone broken in small pieces; this is set on fire, and the box covered over and kept in the open air several hours, the effect of the sulphurous fumes being to bleach the straw. It is the business of one person to split and select the straws for fifty others, who are braiders or plaiters. The splitting is done by a small machine, made principally of wood. The straws, when split, are termed *splints*, of which each worker has a certain quantity; on one end is wrapped a linen cloth, and they are held under the arm, and drawn out as wanted. Plaiters should be taught to use their second fingers and thumbs instead of the fore-fingers, which are often required to assist in turning the splints, and thus much facilitate the plaiting; and they should be cautioned against wetting the splints too much. The finest hats are made in the neighbourhood of Leghorn, whence they are exported in great numbers. The Dunstable manufactures in Bedfordshire, England, are of a fine quality. In the English plait the straws are flattened in a hand-mill previous to working, but in the Leghorn the pressure is applied after the plaiting is made.

**STRAWBERRY** (*Fragaria*), a plant which belongs to the natural order Rosaceae, together with raspberry and the brambleberry. *Fragaria vesca* and other species yield the various kinds of strawberry. This is one of the most wholesome and delicious of our fruits. The pulp is light, melting, and, notwithstanding, but little watery. It exhales a delightful perfume, and the flavour is exquisite. The root gives out several long, slender, creeping shoots, which take root at intervals, and form so many new stocks; the leaves are composed of three leaflets supported on a long foot-stalk, which is provided with stipules at the base. From the midst of the leaves arise two or three simple, slender, silky stems, from 4 to 6 inches high, and terminated by a few white flowers disposed in a sort of corymb. After flowering the receptacle increases, acquires a pulpy and succulent consistence, and finally a red colour when the strawberries have attained maturity. The pulp of the strawberry is not strictly speaking the fruit, which consists of the yellow seeds scattered over its surface. The strawberry is easily cultivated, and numerous varieties have been produced. It forces well, and with a little trouble in choosing a succession of sorts may be had almost every month in the year. An open situation and rich, loamy soil, rather strong, is required for most varieties; and from their large mass of foliage and flowers they must, till the fruit is set, have copious supplies of water. The row culture is most convenient, and frequent renewal insures vigorous plants and large fruit. A palatable jam, wine, and vinegar are prepared from strawberries; and they are sometimes preserved entire in syrup or in wine.

**STREAKS**, the uniform ranges of planks on the bottom or sides of a ship, or the continuations of planks joined by the ends to each other, and reaching from the stern, which limits the vessel forward.

to the stern-post and fashion-pieces, which terminate her length abaft.

**STREETS, PAVEMENT OF.** See PAVEMENT.

**STRELITZ** (Russian, *streltsi* or *strelai*, guards), the life-guards of the Russian czars until the reign of Peter the Great. They were instituted in the latter half of the sixteenth century by Ivan Vasilievich, and formed also the standing infantry of the empire, amounting sometimes to 40,000 men. Their numerous privileges and their frequent insurrections rendered them as formidable as the Roman pretorians or the Turkish janizaries. Peter the Great dissolved the corps in 1697 in consequence of an insurrection, put several thousands to death, and banished the rest to Astrakhan. Having been guilty of some disturbances here they were entirely dispersed and destroyed in 1705.

**STRENGTH OF MATERIALS.** The strength of any material is the resistance which it opposes to alteration of form or to fracture by the application of force, in whatever way the force is applied to it. The practical value of a material for purposes of construction is clearly dependent upon its strength to resist the particular force or pressure to which it may be exposed. There are many forms in which materials may be strained, and a material which may be well qualified for resisting strains of one kind may be deficient in resisting power to oppose other kinds of strains. For instance, stone is admirably constituted for supporting enormous loads, as in the abutments and arches of a bridge, where it is subject only to direct compression or thrust; but it would be very inferior as a material for resisting a direct pull. Again, cast-iron is much superior to wrought-iron in resisting a thrust or compressive stress; whilst, on the contrary, wrought-iron is much superior to cast-iron for resisting a pull or tensile stress. For such reasons it is of prime importance that the strength of materials employed in works of construction and in machinery should be accurately ascertained with regard to their ability to resist strains of various kinds and variously applied; not only to resist ultimate fracture, but also to resist alteration of form even where the material may be abundantly strong enough to resist fracture.

Here it may be mentioned that the word 'strain' has until recent years been universally employed to express not only the yielding or alteration of form of a body under the action of force, but also the force itself. As a verb it is thus defined in the dictionaries: 'To stretch, to draw with force.' The exigencies of scientific precision, however, have caused the substitution of the word 'stress' for the good old engineer's word 'strain,' to distinguish clearly the action of force from the alteration of form produced by the action of force. There are five distinct strains to which a beam, a bar of metal, a block of stone, or any other hard body may be exposed:—  
1st. A body may be torn asunder by a stretching force applied in the direction of its fibres, as in the case of ropes, stretchers, king-posts, tie-beams, &c.  
2d. It may be broken across by a transverse strain, or by a force acting either perpendicularly or obliquely to its length, as in the case of levers, pump-handles, joists, &c.  
3d. It may be crushed by a pressure exerted in the direction of its length, as in the case of pillars, posts, and truss-beams. The foundations of a house are subjected to compression in supporting the weight of the house, and if the weight became excessive they would be crushed.  
4th. A bar may be twisted or wrenched by a torsional force acting in a perpendicular direction at the extremity of a lever or otherwise, as in the case of the axle of a wheel or the crank-shaft of a steam-engine.  
5th. A body may be sheared across by a

shearing force applied laterally, as in the familiar case of a shearing-machine for cutting through iron plates and bars.

The first and most important of these forms of strength or resistance is the tensile strength, or the resistance to stretching by a pulling force. As the force of resistance increases with the breadth and thickness of the body, it is usual to give expression to the force of resistance as equal to so many pounds, hundredweights, or tons per square inch or per square foot of the sectional area of the body. In this way the relative strengths of bodies of various dimensions may be reduced to a standard for the direct comparison of the strength of one with that of another. For example, a bar of iron half an inch square may support a direct weight of 5 tons before it breaks asunder, and a bar of oak 3 inches square may carry endwise a direct weight of 18 tons before it is torn asunder. At first sight it might be inferred that the oak was as strong as the iron, but the true proportion of strength is shown by reducing the resistance to a common unit of sectional area, 1 square inch. The bar of iron half-inch square has a sectional area of one-fourth of a square inch, whilst the bar of wood 3 inches square has a sectional area of 9 square inches. The resistance of the iron is therefore to be taken four times, making 20 tons for 1 square inch of section; and that of the wood is to be divided by 9, making 2 tons per square inch of section as the measure of the tensile strength of the wood.

Tensile strength is by far the simplest of the five strains above recorded, with respect to its mechanical action, but it is the most difficult to submit to experiment, in consequence of the enormous forces that are required to cause rupture even on pieces of small dimensions, and the great difficulty there is in applying those forces in the direct line of the fibres of the body. If this is not done the first rupture may be occasioned by a partial action of the weight on a portion of the fibres only, or by a force of torsion, by which they may be wrenched asunder. The consequence in this case is that the force of direct cohesion will be estimated at less than its real value, and from this circumstance, probably, it arises in a great degree, that so little agreement is found in the results of the earlier experiments that have been made for determining the cohesive force of materials. The strengths of different woods of the same kind, and of different parts of the same piece of timber, may differ very much, as is shown by the experiments of Musschenbroeck, Robison, Buffon, Barlow, and others. Musschenbroeck's experiments were made with great care, and he has given a very minute account of them, particularly those on the strength of ash and walnut. He states the weights required to tear asunder slips taken from the four sides of a tree, and on each side, in a regular succession from the centre to the circumference. His pieces were all formed into slips fitted to his apparatus, and cut down to the form of prisms a fifth of an inch square. He ascertained the weights required to tear asunder these prisms, and when these are multiplied by 25, so as to give the equivalent resistance for a prism 1 inch square, the following are found to be the tensile strengths of the several woods submitted to the test:—

*Strength of Direct Cohesion of Various Woods (Musschenbroeck).*

	lbs.		lbs.
Lonest-tree, .....	20,100	Elder, .....	10,000
Jugoh, .....	18,500	Pomegranate, .....	9,750
Beech, Oak, .....	17,800	Lemon, .....	9,250
Orange, .....	16,500	Tamarind, .....	8,750
Alder, .....	15,000	Fir, .....	8,350
Elm, .....	13,200	Walnut, .....	8,150
Mulberry, .....	12,500	Pitch-pine, .....	7,650
Willow, .....	12,500	Cypress, .....	6,000
Ash, .....	12,000	Poplar, .....	5,500
Plum, .....	11,800	Cedar, .....	4,850

In these experiments it was found that the wood immediately surrounding the pith or heart was the weakest.

The results of recent experiments on the tensile strength of wood of larger dimensions, in which the inequalities of structure of wood are better averaged than they can be in specimens so minute as those of Musschenbroeck, show that the tensile strength of wood is much less than as shown in the preceding table. The following examples of the results of the tests made by Mr. Laselett on specimens 2 inches square, show more nearly what is to be expected from timber as it is ordinarily employed. The weights are those required to tear asunder prisms 1 inch square:—

*Strength of Direct Cohesion of Timber (Laselett).*

	lbs.		lbs.
English oak, .....	6,000	Beech, .....	4,800
French oak, .....	8,000	Elm, .....	5,500
American white oak, .....	7,000	Fir, .....	4,000
Moulmein teak, .....	3,800	Larch, .....	4,000
Iron-wood, .....	9,600	Cedar, .....	3,900
Greenheart, .....	8,800	Red-pine, .....	2,700
Mahogany, .....	3,400	Yellow-pine, .....	2,500
Blue-gum, .....	6,000	Pitch-pine, .....	4,700
English ash, .....	3,800	Kauri-pine, .....	4,000

From this table it is apparent that English oak, the king of trees, is in reality not the strongest wood, although a prism of this wood 1 inch square is capable of supporting a load of about 3 tons. Fir, the other wood most frequently employed in construction, is seen to have two-thirds of the tensile strength of oak, and to be capable of supporting about 2 tons by a prism 1 inch square.

But these values, it should be clearly understood, are average values; for the strength of wood varies extremely, according to the condition of seasoning and the specific gravity. The heavier the wood is, in general, the stronger it is.

Great as is the strength of timber for supporting loads tensilely, it is much less than that of cast-iron, and very much less than that of wrought-iron and steel. Cast-iron of average quality will bear a load of from 6½ to 7 tons on a prism of 1 square inch; wrought-iron bars carry as much as 24 tons per square inch before being fractured, whilst steel bars support from 30 to 50 tons per square inch. Hence it is that these metals have for the most part taken the place of timber in the construction of bridges, steamers, and machinery; in which their immense strength, rigidity, and compactness confer upon them an unchallenged superiority.

*Resistance of Materials to Crushing.*—Great as the resistance of materials is to tensile strains, their capacity of resistance to a crushing force generally exceeds their tensile resistance. Wood, however, forms an exception to this rule, for it has been found that cubical blocks of various woods fall to pieces under loads about the same as those which would be required to tear asunder pieces of the same breadth and thickness. But cast-iron resists compressive stress with a force from four to six times as great as its resistance to tensile force, exceeding that of wrought-iron. Hence cast-iron is well adapted for supporting superincumbent loads, and it has been much employed in the construction of bridges and foundations, as well as in the heavy and massive framework of steam-engines and machinery.

The enormous weight which even timber is capable of bearing was practically shown in many operations in the construction of the Britannia Bridge. The gigantic iron tubes composing the bridge rested on some occasions on beech wedges under each extremity, with a pressure of 30 tons per superficial foot. They were frequently supported on a pile of soft deal planking under each end, 6 feet high, with a pressure

of 20 tons on each square foot of surface. In one instance, when the hydraulic press employed in raising one of the tubes failed, the extremity of the tube fell on to a bed of soft deal planks piled loosely on each other about 4 feet high, 5 feet wide, and 12 feet long. The tube fell through a height of only 14 inches upon the planks, yet they sank and were compressed under the great weight through a space of about 7 inches. At the same time, half the weight of the tube, or about 1000 tons, was supported by a cubical deal block measuring 14 inches high and 14 inches square.

Mr. Edwin Clark tested the resistance of blocks of sandstone to crushing, by imposing weights upon them. He found that they bore about 1 ton per superficial inch, or 144 tons per superficial foot, which was equivalent to a superincumbent column of the same material, 2351 feet in height. That is, if a column of the stone, 2351 feet high, had been reared upright and supported on one end, it would have just sufficed to crush, by its own weight, the lower portions at the base. Similarly, blocks of Anglesey limestone required a load of 471 tons per square foot to crush them, equivalent to a column of the same material 6433 feet high. Brickwork was found to resist crushing with a force of only 33½ tons on the square foot, equivalent to a column of brickwork 584 feet in height, showing that brickwork had only a fourth of the resistance of sandstone, and only a fourteenth part of that of limestone.

*Elasticity of Materials.*—All materials yield or spring to a greater or less extent, though in very different degrees, when force is applied to them, and therefore they are said to be more or less elastic. Glass, it is well known, is exceedingly brittle, that is, its elasticity though perfect, is confined to a very limited range; and if glass be strained beyond this elastic range, fracture ensues. A watch-spring is an example of an excessively extended range of elastic action under the application of force: it may be wound six, eight, or ten times over itself on a fixed axis. India-rubber, similarly, may be extended to many times its normal length under tensile force. The steel springs of carriages and vans are familiar cases of great range of elasticity or 'action.' If deprived of this capacity for yielding under pressure and returning to their normal form when relieved of the pressure, solid bodies would become absolutely brittle, and would fall to powder on the slightest percussive action of force applied to them.

The following are the increased lengths of a bar 50 feet long, of several materials ordinarily employed in construction, when subjected to a tensile stress of 1 ton on each square inch of sectional area:—

Teak, . . . . .	50 feet normal length, stretched to 50 feet 1½ inches.
Oak, . . . . .	" " " 50 " 1 " "
Fir, . . . . .	" " " 50 " 1 " "
Cast-iron, " " " "	50 " 1 " "
Bar iron, " " " "	50 " 1 " "
Steel, . . . . .	" " " 50 " 1 " "

Whilst teak, at one end of the scale, stretches 1½ inches in 50 feet, for 1 ton of tensile force on each square inch; steel, at the other end, extends the almost imperceptible quantity of only 1/16th of an inch under the same stress. Hence it is that wood, with its greater elastic range of action, is better fitted for resisting direct impact, than metals, and is employed in the construction of fenders in tide-ways, for the buffer-beams of locomotives, for the foundations of steam-hammers, and in other situations where the material is exposed to concussive shocks.

The tensile strength of iron-wire is well-known. It is proportionately much greater than that of the original bar from which the wire is drawn, and the additional strength gained is attributable to the har-

dening of the surface of the wire by the action of wire-drawing. The tensile strength of fine iron-wire is equivalent to about 85 tons per square inch. That of steel-wire is proportionally greater. Indeed, steel-wire has been manufactured which would carry the enormous weight of 800,000 lbs., or 135 tons per square inch.

*Transverse Strength of Beams.*—When a beam of any material is laid upon two props, and loaded with a weight applied at the middle, it sinks or deflects under the load by an amount which is called the deflection; and the quantity of the deflection increases in proportion to the load, until, when the elastic property is overcome, the beam sinks more rapidly as the load is increased, until fracture ensues. This property of the equality of the increments of deflection under equal increments of load, is maintained so long as the beam is not strained beyond the *elastic limit*. Beyond the elastic limit, the strain injures the beam; and the property just described is of great utility in supplying a measure by which the proper working strength of a beam may be determined.

It is found that the stiffness, or the resistance to deflection, of beams increases in a rapid proportion as the depth is increased; namely, as the cube of the depth. Take, for example, two solid rectangular beams, as wooden joists, of which one is double the depth of the other, the stiffness of the deeper beam is eight times as much as that of the shallower beam. Hence the advantage of depth for the sake of stiffness, and to reduce the deflection. At the same time, the absolute strength, or resistance to fracture, is also increased in proportion to the depth, in the ratio of the square of the depth; so that one beam twice as deep as another, has four times the strength.

Although timber beams are formed of a rectangular section, it is different with iron beams, whether of cast-iron or wrought-iron. These are formed for the most part of a double T section, like the letter H laid on its side; and consist of an upper and a lower table, head, boom, or flange, as they are variously called, connected by a vertical web. By this arrangement much greater strength is derived for a given weight of material, than in beams of simple rectangular form. Large girders constructed for bridges are usually constructed with lattice work instead of webs for connecting the upper and lower flanges. Examples in both kinds are given at the article BRIDGE, where various particulars regarding the construction of bridges will be found. When the span of a girder is of great length, the deflection may be very considerable. Thus, the Conway iron tubular bridge, having 412 feet of span, has a deflection of 10 inches at the centre; and the large tubes of the Britannia Bridge, of 470 feet span, have a deflection of 1 foot at the centre.

Wrought-iron flange-joists are now rolled in long lengths of one piece, from 12 to 20 feet in length; they are extensively used in the construction of buildings.

When a beam is loaded at the middle of the span the stress on the material is greatest at the centre, and diminishes as the ends are approached. It is, therefore, obvious, that the strength of the beam would not be diminished, if, instead of having a uniform section from end to end, it were gradually reduced from the centre towards the ends, proportionally to the reduction of stress. A beam so formed is said to be of uniform strength, and the normal figures of a few such beams are shown at figs. 1, 2, &c., in which the load is represented, for the sake of simplicity, by a ball. The first three figures, 1, 2, 3, represent semi-beams, or cantilevers, fixed at one end to, and projecting from a wall, with a load hanging from the extremity. The first

of these is a solid rectangular beam, of which the breadth is uniform from end to end, but the depth is a maximum at the wall, and is diminished as it approaches the extremity. The form of the side is that of a semi-parabola. The second figure is formed on a different principle; for, whilst the depth of the

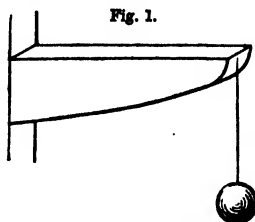


Fig. 1.

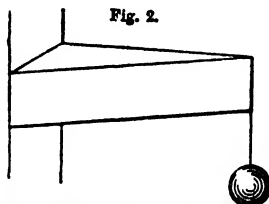


Fig. 2.

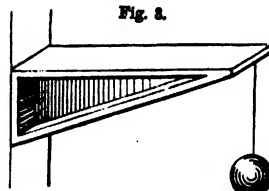


Fig. 3.

Cantilevers fixed at one end and loaded at the other.

beam is uniform from the wall to the end, the breadth, which is a maximum at the wall, diminishes towards the end; the form of the beam in this case is that of

a triangle in plan. The third figure is triangular in side elevation, but the peculiarity of it is that the beam is formed of a I section, or flanged above and

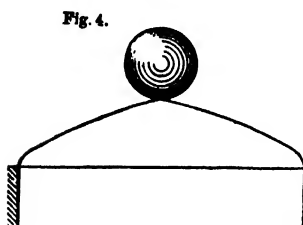


Fig. 4.

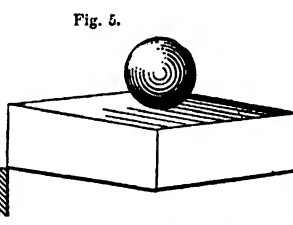


Fig. 5.

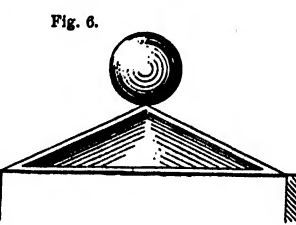


Fig. 6.

Beams supported at both ends and loaded at the middle.

below. The other three figures, 4, 5, 6, represent the normal forms of beams supported at both ends, with a load at the middle. These figures, it may be

remarked, are simply doubles of the elementary figures, 1, 2, and 3, joined together at their bases.

Again, the forms of beams of uniform strength,

Fig. 7.

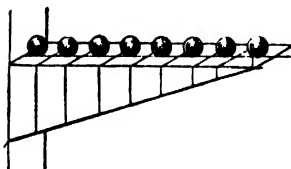


Fig. 8.

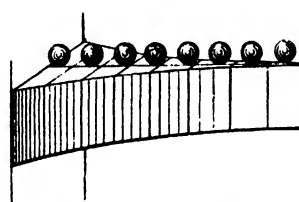
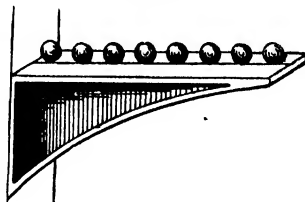


Fig. 9.



Cantilevers uniformly loaded.

when the weight is uniformly distributed over the length of the beam, follow different outlines from those in which the load is concentrated at the middle. These are shown for semi-beams, with the load uniformly distributed, in figs. 7, 8, 9. The load is represented by a row of balls resting on the

beam from the wall to the extremity. In fig. 7 it is seen that the form of the side becomes triangular, when the breadth is maintained uniform, and in fig. 8 the form consists of two parabolic curves in plan, when the depth is uniform; whilst in fig. 9, a flanged semi-beam, with a uniform breadth, the

Fig. 10.



Fig. 11.

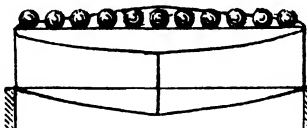
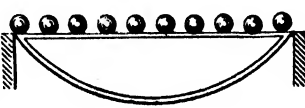


Fig. 12.



Beams uniformly loaded.

lower side is hollow, according to the form of a parabola. When the beam is supported at both ends, figs. 10, 11, 12, with a distributed load, the form of the beam fig. 10, having a uniform breadth, is that of a semi-ellipse in side elevation; that of the beam fig. 11, of uniform depth, consists of two parabolas

joined base to base at the middle; and that of the beam, fig. 12, consists of a single parabola, having its apex at the middle of the beam.

Whilst these figures correctly indicate the normal forms of uniform strength, beams are not constructed exactly according to such forms, but they are made

as nearly so as is permitted by the nature of the material, and the requirements for support and connections at the ends of the beams. It is easy to see the importance of a knowledge of the forms of uniform strength, since economy of material may thereby be effected, at the same time that the strength of the beam remains the same.

**Torsional Strength of Materials.**—The main shafts of steam-engines and water-wheels are cases of iron and steel subjected to torsional or twisting stress. In a marine engine, the former applied through the crank at one end is transmitted to the paddle-wheel, or the screw, at the other end. Torsional stress exerts a very severe action on metals, and it tries their solidity and tenacity more than any other form of stress. But the torsional strength of shafts increases very rapidly as the diameter is enlarged—as the cube, or third power of the diameter; so that one shaft having double the diameter of another, has eight times the resisting power of the smaller shaft.

**Hollow Forms of Material.**—The distribution of material in hollow forms conduces to the greatest strength and stiffness in combination with the minimum consumption of material. On this principle Sir Joseph Whitworth introduced the method of the hollow, cored, or box casting for the frames of machine-tools. The capacity of the box-casting for resisting strains of every variety, is amazing. Bones of animals are formed with the nicest regard to the obtaining of the maximum of strength with the minimum of material. They are invariably either structurally hollow or flanged. The goose-quill is a familiar instance of the hollow construction; and there are many instances in the vegetable kingdom of the extreme rigidity and strength of circular tubes. The stems of the grass tribe generally are remarkable for their strength and lightness; the common wheat-straw and the river-reed are familiar examples in our own climate, but in the tropics the gigantic stems of the bamboo and other grasses tower 60 feet above the jungle, and they are extensively employed as beams for covering buildings, and even for suspension-bridges. The angler's bamboo rod is the most perfect of tubular beams. Tapered off in proportion to the strain, its silicious coat defies compression, whilst it is lined with woody fibre to resist extension in every direction.

**STREPSIPTERA** ('twisted-winged'), a very peculiar and anomalous order of Insects, represented by the *Stylops* or *Bee-parasite*, the females of which exist as wingless and footless grub-like forms, which live as parasites in the bodies of Bees, Wasps, and other Hymenopterous Insects. The order is defined by the above characters of the female insects, the males being winged, but possessing the hinder pair of wings alone—the front wings being represented by a pair of twisted filaments, from the presence of which the name of the order is derived. The wings are membranous, and are folded longitudinally, or like a fan, when at rest. The jaws are rudimentary. The heads of the parasitic females protrude from between the joints of the abdomen of the bees they infest. The eggs of these females are fertilized by the male whilst they are still contained within the body of the former, the larvæ being hatched from the eggs within the body of their parent. The larvæ are little caterpillars, and possess six feet, and by attaching themselves in turn to the bodies of wasps and bees are thus conveyed into the nests of their hosts. The female larvæ then simply develop a horny head, and remain in their normal and parasitic situation; but those larvæ which are to become males undergo their metamorphosis within the bodies of their hosts, from which in due time the perfect winged males emerge. These insects are thus *Holo-*

*metabolic*—that is, they undergo a complete or perfect metamorphosis. It is doubtful if the males eat after attaining their perfect state, their life being apparently of very short duration. *Stylops Dalii* and *S. Spencii* are familiar species. The eyes consist of remarkably few lenses, and the antennæ or feelers are often curiously branched.

**STREPSIRHINA** ('twisted-nostrils'), one of the three chief divisions into which the order Quadrumana or Monkeys is arranged. This is the lowest group, and is represented by such forms as the Aye Aye or Cheiromys of Madagascar, by the Lemurs, Loris, and similar forms. The Strepsirhine Monkeys are recognized by their curved or twisted nostrils, which are placed at the extremity of the snout. The incisor teeth exhibit great variations in form and shape, and usually number three in each side of each jaw, the lower incisors being projecting and slanting. The premolars number six or four in each jaw. The second digits or toes of the hind feet are provided with claws, and five toes exist on all the feet, the thumbs being 'opposable' to the other fingers, thus constituting 'hands.' The names *Prosimia* or *Lemuroidea* are often given to this group of monkeys in allusion to their lower grade as compared with other Quadrumana. The families of this division include that of the Cheiromyidae, represented by the Aye-Aye. In this family no canine teeth exist, the incisors growing from permanent pulpa, like those of Rodentia (which see), whilst the tail is bushy, and the claw of the second digit of the hind limb is very long. The Nycticebidae include the Loris and Slow Lemurs (see LEMUR), no tail existing in this group; whilst the third and last family, that of the *Lemuridae*, includes the True Lemurs, which possess elongated muzzles and a long tail. See also such articles as MAMMALIA, MONKEYS, QUADRUMANA, &c.

**STRESS AND STRAIN**, the load stretching or crushing a bar or portion of material, and the amount by which the bar is elongated or shortened, when the elongation or shortening is within the limits of elasticity of the material: the theory of the behaviour of bodies when subjected to forces which will produce distortion. It is only recently that the terms stress and strain have received definite and separate meanings. In one of the best English text-books on the subject (Stoney on Strains) these terms are used indiscriminately. Precision of language is secured by adopting the meanings given above. When a weight hangs from a bar we may talk of the weight as being the stress on the bar, or we may think of the cross-sectional area of the bar and consider the weight as a stress of so much per square inch of section. The stress inside a steam boiler is always considered as a stress per square inch; and, indeed, in most cases, stresses should be so considered except where the total stress is either the result or part of the data of an investigation. It has been proposed to call stress per unit area of section stress intensity. Strain is proportional to stress. If we take an inch bar of a substance and hang on it a certain weight, say 50 lbs., and find that the bar has lengthened  $\frac{1}{1000}$ th part of its length, then 100 lbs. would elongate it  $\frac{2}{1000}$ th parts of its length. If 50 lbs. be applied as a pressure the bar will shorten  $\frac{1}{1000}$ th of its original length, and 100 lbs. will shorten it  $\frac{2}{1000}$ th parts. It has been proposed to call the strain expressed in a fraction of the length strain degree, or the degree of strain. A steel wire whose section is a millimetre in area will be elongated  $\frac{1}{1000}$ th of its length by a weight of 1 kilogramme. The smaller the fraction of elongation the stiffer or more rigid the body, and its elasticity may be represented by the reciprocal of the fraction; 21798 is therefore the modulus of elasticity for steel referred to the kilogramme and milli-

metre. This is known as Young's Modulus. Suppose the elasticity of the substance to remain perfect till 21793 kilogrammes have been applied, then the wire would have doubled its length; and Young's Modulus is sometimes described as a weight in understood units which will either lengthen a bar of unit area to twice its length or shorten it to zero, supposing its elasticity of form perfect. Besides direct pressure and its effects shearing stresses and strains and torsional stresses and strains are spoken of. See **STRENGTH OF MATERIALS**.

**STRICKLAND, AGNES**, an English authoress, born in London on Aug. 19, 1796, was the daughter of Thomas Strickland, of Reydon Hall, near Southwold, Suffolk, by his second wife. Together with her sisters Catherine Parr (Mrs. Traill), Elizabeth, Jane Margaret, and Susanna (Mrs. Moodie), she devoted herself to literature, and became the author of numerous works in prose and verse, those of the lighter kind being mostly now forgotten. Her most valuable works, written in conjunction with her sister Elizabeth, are, *Lives of the Queens of England from the Norman Conquest (1066-1714)*, with Anecdotes of their Courts; from Official Records and other Authentic Documents (twelve vols. post 8vo, 1840-48); and *Lives of the Queens of Scotland and English Princesses connected with the Royal Succession of Great Britain* (eight vols. post 8vo, 1850-59). She also published *Letters of Mary Queen of Scots*, with an Historical Introduction and Notes (three vols. post 8vo, 1842-43; new edition, revised, five vols. 1864); *Lives of the Bachelor Kings of England and Lives of the Tudor Princesses* (post 8vo, 1868). She died 13th July, 1874.

**STRIEGAU**, a town of Prussia, province of Silesia, 27 miles w.s.w. of Breslau, on a stream of same name. It has a court of law and several public offices, a fine Roman Catholic church besides other churches, manufactures of leather goods, albums, cigars, agricultural machines, &c., granite and basalt quarries. On 4th June, 1745, the Austrians and Saxons were defeated here by Frederick the Great. Pop. (1895), 12,627.

**STRIKE**. See **TRADES'-UNIONS**.

**STRIX**. See **OWL**.

**STROBILA**. See **TAPE-WORM**.

**STROMBOLI**. See **LIPARI ISLANDS**.

**STROMBUS**, a genus of Gasteropodous Mollusca, included in the family Strombidae, in which group the shell has a deeply notched expanded lip, with a claw-shaped *operculum* or plate for closing the shell. The foot is narrow, and may be adapted for leaping. Theseshells belong to the Siphonostomatous or Siphon-mouthed Gasteropods, in which the mouth of the shell is perforated for respiratory siphons. A very notable species is the Giant Stromb or Fountain-shell (*S. gigas*), a West Indian species, which may weigh from 4 to 5 lbs., and which is imported in large quantities into Europe, from its furnishing the materials from which cameos are cut.

**STRONSA**, or **STRONSAY**, one of the most easterly of the Orkney Islands; lat. (south-east point) 59° 4' 54" N.; lon. 2° 32' W.; about 7 miles long and 5½ miles broad. Its coasts are marked with deep indentations and numerous headlands and promontories. The surface is of moderate elevation, with exception of a central ridge. Oats, bere, potatoes, pease, and turnips are grown. The white-fish, lobster, and herring fisheries are prosecuted here with some vigour. Pop. (1881), 1274; (1891), 1275.

**STRONTIA**. See **STRONTIUM**.

**STRONTIUM**, a dark-yellow metal first obtained from the carbonate of Strontia by Sir H. Davy in 1808; sym. Sr.; at. wt. 175; sp. gr. 2.54. When exposed to the air it attracts oxygen, and becomes

converted into strontia, or protoxide of strontium; when thrown into water it decomposes with great violence, producing hydrogen gas, and forming with the water a solution of strontia. Strontia has the same relation to the metal that lime has to calcium, and one of its most important compounds is the carbonate, or strontianite, which was discovered at Strontian, in Argyleshire, in 1787. The nitrate is extensively used in producing the bright crimson lights of fireworks.

**STROPHE** (Greek, *strophē*, from *strephō*, I turn), the name of one of the divisions of a Greek choral ode. The singing of the strophes on the stage was accompanied with a motion or turn from right to left towards the images of the gods placed on the sides of the orchestra (in the ancient sense of this word); but the singing of the antistrophe, with a contrary motion, from the left to the right.

**STROUD**, or **STROUDWATER**, a town of England, in the county of Gloucester, near the confluence of the Slade and Frome, and on the Great Western and the Midland Railways. It has several spacious streets, many handsome houses, a parish church with a tower terminating in a lofty octangular spire, various other places of worship, grammar and other schools, a dispensary, a hospital, and a fine cemetery. The staple manufacture is woollen cloth, which employs numerous factories both in and near the town. Ready-made clothing is extensively manufactured, and dyeing is largely carried on. There are also shoddy mills and manufactures of pins, walking-sticks, umbrella furnishings, &c. Up to 1885 Stroud returned two members to Parliament (the borough embracing much more than the town proper), but in that year it was merged in Mid-Gloucester. Pop. (1881), town, 7848; (1891), 9818; (1901), 9188.

**STRUENSEE, JOHANN FRIEDRICH, COUNT OF**, born in 1737 at Halle on the Saale, where his father, Adam Struensee, author of the old Halle Hymn-book, was pastor of St. Ulrich's church. He was the second son of a family of seven, and received the elements of his education in an orphanage; he afterwards studied medicine, and passed as doctor before he had reached the age of nineteen. He entered upon the practice of medicine at Altona, where he formed an acquaintance with the Count of Rantzau-Aschberg and with Enevold Brandt, formerly a page in the service of Christian VII., king of Denmark. He was a skillful physician, was possessed of a fine personal appearance and elegant manners, and was soon the most popular man of his profession in the place. In 1768 he was appointed physician to the King of Denmark, whom he accompanied on his travels through Germany, England, and France. After Christian's marriage with Caroline Matilda a coolness arose between the royal pair, of which the queen-dowager took advantage to promote the interests of her son, Christian's half-brother. The birth of a crown prince, Frederick VI., widened the breach between Caroline and the queen-dowager, without reconciling Christian to his wife. The nation was divided into two great parties—that of the king, at the head of which was the young count Holck, the royal favourite, and that of the queen-dowager at Friedensburg. Caroline Matilda aimed at effecting the removal of Holck, with the hope of regaining the king's favour, while Holck endeavoured to increase the distance between her and the king. Thinking Struensee to be as warmly opposed to the queen as he was himself, he advised Christian to employ him in his messages to the queen. But this proved the ruin of Holck: the king became more and more attached to Struensee, and the queen, who observed the change and contrasted the respectful deportment of Struensee with the arrogance of the favourite, soon admitted him to

her confidence; and he effected a reconciliation between her and the king. Struensee now pursued his ambitious plans with redoubled zeal. Bernstorff, the chief minister of state, was removed; Brandt succeeded Holck as director of the theatre and master of the court amusements, and the friends of the queen were brought into office. To secure his influence Struensee endeavoured to occupy the king with amusements, and particularly to prevent him from communicating directly with his ministers. In 1770, at the instigation of Struensee, the king abolished the council of state, establishing, in place of it, a committee of conference, consisting of the heads of the different departments of the administration, who were only occasionally assembled, and had neither rank nor influence. This measure threw all authority into the hands of the queen and the favourite, and roused the indignation of the Danish nobility, who had enjoyed a seat and vote in the council. Struensee next procured the removal of the old ministers; and all affairs were now administered in the name of the king by his personal attendants. But the favourite had neither prudence nor firmness to support him in this situation. He became overbearing and impatient of contradiction, and attempts to introduce reforms in the finances, the army, law, &c., though excellent in themselves, were carried out with such haste and manifest want of statesmanlike skill, that they raised him up many enemies. He now caused himself to be created count, and, not satisfied with this, procured the dignity of cabinet-minister, with such powers as no Danish minister had ever before possessed. When his enemies attempted to expose his usurpations, the freedom of the press, which he had himself introduced, was subjected to restrictions. But the friends of Struensee were already becoming cool towards him, and the people began to show symptoms of dissatisfaction. Struensee was conscious of his danger, and took some precautions to defend himself. But on the night of January 16, 1772, the queen, the favourite, Brandt, and their other partisans were seized. The officer who commanded the guard (an old enemy of Struensee) had led his officers into the palace, declaring that the king had commanded him to arrest the queen. Count Rantzau-Aschberg then penetrated to the chamber of the king, waked him, and told him that his life was in danger, and that he must sign an order which the count presented to him. The feeble king obeyed, and the queen was conducted to Kronenburg. An extraordinary commission was instituted for the trial of Struensee, consisting in part of his personal enemies. He was charged with having committed an assault on the person of the king, with having criminal intercourse with the queen, with fatally misdirecting the education of the young crown prince, with attempting to compel the king to abdicate, and with usurping and abusing the royal power and privileges. None of these charges could be legally proved, but on a second examination Struensee confessed to having had improper intercourse with the queen; a confession dragged from him, according to some of his contemporaries, by the threat of the rack. Similar means were employed to induce the queen to sign a document containing the confession of her guilt. Struensee was thus proved guilty of a capital crime, and, on the 25th of April, he was condemned to lose his right hand and his head, his body to be quartered and exposed upon the wheel, and his head and hand to be stuck upon a stake. When informed that the king had confirmed the sentence he received the news with composure, and was executed on the 28th of April, 1772. His friend Brandt suffered the same fate at the same time. There can be no doubt that both were innocent of crimes deserving capital punishment, Brandt especially having taken no part in the

acts of government; but the party of the nobles dreaded their influence too much, and could not suffer them to live. Struensee's brother, Karl August, a celebrated mathematician and military engineer, afterwards a privy-councillor of finance in the Prussian service, only escaped execution through the exertion of Frederick the Great, who claimed him as a subject.—The story of Struensee has been brought before the popular attention in recent times by the tragedies of M. Beer and H. Laube.—See Høst's Count Struensee and his Ministry (in Danish, 1824, and more complete in German, 1826); *Mémoires de Falkenskjold* (Paris, 1826), and *Die Verschwörung gegen die Königin Karoline Mathilde und die Grafen Struensee und Brandt* by Jensen-Tusch (Leipzig, 1864).

#### STRUTHIO. See OSTRICH.

STRUTT, JOSEPH, antiquary, born on Oct. 27, 1749, at Chelmsford, was educated at King Edward's School, Chelmsford. He was articled to W. W. Ryland, the engraver, and obtained the gold and silver medals of the Royal Academy. He published, in 1773, *Regal and Ecclesiastical Antiquities of England*, containing representations of the English monarchs from Edward the Confessor to Henry VIII. This was followed by *Horda Angel-Cynnan, or a Complete View of the Manners, Customs, Arms, Habits, &c., of the English, from the Arrival of the Saxons to the Times of Henry VIII., &c.* (1774, 1775, and 1776, three vols., with 157 plates). In 1777 and 1778 he published a *Chronicle of England*, which he meant to extend to six volumes, but dropped the design after he had completed the second volume, for want of encouragement. His *Biographical Dictionary of Engravers* appeared in 1785 and 1786, in two vols., and his *Complete View of the Dresses and Habits of the People of England, &c.*, in 1796 and 1799, two vols. 4to, with 142 plates. In 1801 he published his last and favourite work, entitled *The Sports and Pastimes of the People of England* (with forty plates; new octavo edition, with 140 plates, 1827). His modest character scarcely met, during his lifetime, with the encouragement it deserved, and he died in London on the 16th October, 1802, in rather straitened circumstances. He left some manuscripts, from which were afterwards published his *Queenhoo-Hall*, a romance, concluded by Sir Walter Scott; and *Ancient Times*, a drama (four vols. 12mo); also *The Test of Guilt*, a dramatic tale. See *The Life by Miller Christy* (1898).

STRYCHNINE ( $C_{21}H_{22}N_2O_8$ ), an alkaloid existing in nux-vomica (which see), St. Ignatius beans, and in various other varieties of *Strychnos*. Strychnine may be prepared from nux-vomica by treating with alcohol acidulated with sulphuric acid, adding lead acetate to remove colouring matter, &c., precipitating with magnesia, treating the precipitate with alcohol, and crystallizing. When pure, strychnine forms white four-sided prisms, which are permanent in the air, indourous, fuse without decomposition, and are intensely poisonous. One-eighth of a grain of strychnine is sufficient to kill a large dog; three-eighths of a grain produces violent tetanic spasms in man, while half a grain has been known to prove fatal. Some persons, however, have taken so much as 2 or 3 grains of strychnine without fatal results. Strychnine resists putrefaction, and may therefore be detected in bodies which have been buried for a long time. This alkaloid combines with acids, forming a series of well-defined salts; a series of strychnine derivatives is also known, in which the hydrogen is partly replaced by such groups as ethyl ( $C_2H_5$ ), amyl ( $C_5H_{11}$ ), &c.

STUART, THE FAMILY OF. This house derives its name from the important office of steward of the royal household of Scotland. The name is often written *Stewart*, and occasionally *Stewart*. The form

of *Stuart* was first assumed when Queen Mary went to France, and was adopted by all her descendants. The form *Stewart* is adapted by off-shoots, generally illegitimate, of the royal house previously to Queen Mary. Those who belong to the principal branches which diverged from the main line prior to its becoming royal, retain the original spelling, *Stewart*. The founder of the house seems to have been a Norman baron named ALAN, a follower of William the Conqueror, who bestowed on him the lands and castle of Oswestry, in Shropshire. His eldest son, WILLIAM, became the progenitor of the Fitzalans, earls of Arundel, whose title and lands ultimately went by an heiress into the family of the Dukes of Norfolk. His second son, WALTER, entered the service of David I. of Scotland, by whom he was appointed *dapifer*, that is, meat-bearer, or steward of the royal household. (See STEWARD OF SCOTLAND, THE HIGH.) The steward obtained from David the lands of Renfrew, Paisley, Pollock, Cathcart, and others in that district; he founded the abbey of Paisley in 1160, and died in 1177. His son, ALAN, died in 1204, leaving a son, WALTER, who held, in addition to the office of steward, that of Justiciary of Scotland. He died in 1246. His third son, WALTER, obtained by marriage the earldom of Menteith. The eldest son, ALEXANDER, the fourth steward, seized the islands of Bute and Arran, in the right of his wife Jean, heiress of James, lord of Bute. This led to the expedition of Haaco of Norway, and the battle of Largs (3d October, 1263), in which the steward is said to have commanded the right wing of the Scots, greatly contributing to the defeat of the Norwegians. Alexander had two sons, JAMES, the fifth steward, and JOHN, known in history as that Sir John Stewart of Bonkyl, or Bonkill, who was killed at the battle of Falkirk (22d July, 1298). The eldest of Sir John's sons, ALEXANDER, was the ancestor of the Stewart earls of Angus; the second, ALAN, of the Stewart earls and dukes of Lennox; the third, WALTER, of the earls of Galloway; the fourth, of the Earls of Athol, Buchan, and Traquair, and the Lords Lorn and Innermeath. James, the elder brother of Sir John, succeeded as fifth steward in 1283. Three years later, on the death of Alexander III., he was chosen as one of the regents of the kingdom. In the subsequent competition for the crown, he was one of the auditors on the part of the Bruce; he fought bravely under Wallace for some time, but submitted to Edward I. in 1297. In spite of the most solemn oaths which the English king obliged him to take, he died in the service of Bruce in 1309. His son, WALTER, the sixth steward, had an important command in the Scots army at Bannockburn. Some time after, King Robert bestowed the hand of his daughter Marjory upon him, a union which brought the crown of Scotland, and eventually that of Great Britain into his family. He successfully defended Berwick against a greatly superior force under Edward II., and in 1322, in an incursion into England, he all but succeeded in taking that king prisoner. Walter died, in 1326, at the age of thirty-three, deeply lamented by the whole nation; he was succeeded by his son, ROBERT, the seventh steward. During the long and disastrous reign of David II., the steward distinguished himself by his patriotic exertions for the defence of Scotland, defeating the intrigues of that prince and Edward III. to seat Lionel, duke of Clarence, on the Scottish throne. On the death of David, without issue, the steward peacefully succeeded to the crown as Robert II., on the 22d February, 1371, and died in 1390. He was twice married, first to Elizabeth, daughter of Sir Alexander Mure of Rowallan, by whom he had four sons and six daughters; and secondly, to Euphemia, daughter

of the Earl of Ross, by whom he had two sons and four daughters; he had, besides, a numerous illegitimate progeny by various women. ROBERT, his second surviving son, by the first marriage, became in the right of his wife, Earl of Fife, and was afterwards created Duke of Albany by his weak and indolent brother Robert III. On this king's death, Albany became regent of Scotland. By his first wife Margaret, countess of Menteith, he had a son, MURDOCH, who succeeded to the regency; his second wife, Muriella, daughter of Sir William Keith, the Marischal, bore him three sons, one of whom, JOHN, created Earl of Buchan, entered the service of Charles VII. of France, and was appointed Constable of France after the battle of Baugé. On the restoration of James I., regent Murdoch and two of his sons were executed by his order; the youngest son, James, known as James the Gross, escaped to Ireland, where, by a lady named Macdonald, a descendant of the Lords of the Isles, he had a family of seven sons and one daughter. Some of the sons were legitimated, and raised to high honours by James II. The eldest was created Lord Avandale, and another was the progenitor of the earls of Arran; from James, the youngest son (not legitimated) of James the Gross, sprang the Stuarts of Ardvorlich, Glenbuckie, and many families of Stuarts in Perthshire. The fourth son of Robert II., Sir Alexander Stuart, called from his ferocity the Wolf of Badenoch, was created Earl of Buchan, and ruled over the north of Scotland with despotic sway. He had no legitimate issue. One of his natural sons stormed the castle of Kildrummy, the residence of the Countess of Mar, forcibly married that lady, and took possession of the earldom. Another son, JAMES, was the ancestor of the Stuarts of Garth, from whom the most of the family known as the Athole Stuarts are descended. A natural son of Robert II., Sir John Stuart, was appointed hereditary sheriff of Bute and Arran; one of his descendants, Sir James Stuart, was made a baronet in 1627; the grandson of the baronet was a privy counsellor of Queen Ann, and was created Earl of Bute, and during the life of the fourth earl, the earldom was raised to a marquise. Two grandsons of the third earl were raised to the peerage as Lord Wharnclyffe, and a grandson of the first marquis as Lord Stuart de Decies. For the subsequent history of the royal line, see the articles ROBERT II. and III.; JAMES I., II., III., IV., V., MARY STUART; JAMES I. (OF ENGLAND); CHARLES I. and II.; JAMES II.; WILLIAM and MARY, and ANNE.

James II. of England was twice married, first to Anne Hyde, daughter of Lord Clarendon, by whom he had Mary, queen of William III., and Anne, both of whom died leaving no issue. His second wife, Mary of Modena, gave birth, on the eve of the revolution, to James Edward Francis, Prince of Wales, commonly called the old Pretender, or the Chevalier St. George. The legitimacy of this prince was long doubted; a great majority of the nation was convinced that the queen had never given birth to a child; but that there was no imposture is now a matter of historical belief. On the outbreak of the revolution, the queen and her infant son took refuge in France, and on the death of the ex-king, Louis recognized the child as King of England by the title of James III. In 1715 an attempt was made to seat him on the throne of his ancestors by force of arms. The Jacobites, as the Stuart party was termed, were crushed in Scotland by the Duke of Argyle, and in England by General Willes. James Edward, who had landed in Scotland after his cause had been irretrievably lost, succeeded in making his escape. France, however, no longer offered him an

asylum, as the Regent Orleans wished to stand well with the English government, and the Pretender went to Rome, where he lived in obscurity until his death in 1766. In 1720 he married the Princess Maria Clementina Sobieski, grand-daughter of John Sobieski, king of Poland, one of the wealthiest heiresses in Europe, by whom he had two sons, Charles Edward Lewis Casimir (see CHARLES EDWARD STUART), and Henry Benedict Maria Clement, born at Rome in 1725. In 1745, when the last effort was made for the restoration of his family, Henry Benedict assumed the command of the troops assembled at Dunkirk to aid the operations of his brother in Britain, but the news of the battle of Culloden prevented the embarkation of this armament, and Prince Henry returned to Rome. He took holy orders, and in 1747 was raised by Benedict XIV. to the purple. On the death of his brother in 1788, he assumed the barren title of Henry IX., king of England. When the French conquered Italy he was obliged to flee to Venice, where, stripped of his bishoprics and rich church livings, he lived in great poverty until George III. settled on him a pension of £4000, which he enjoyed till his death in 1807. Next to the children of James II. in representation of the royal Stuart family, come the descendants of Henrietta Maria, daughter of Charles I., and wife of Philippe, duke of Orleans, brother of Louis XIV. of France. This princess gave birth to two daughters, Mary, who married Charles II. of Spain, but had no issue, and Anna Maria, wife of Victor Amadeus, king of Sardinia. The last male representative of this line was Francis V., ex-duke of Modena, who died childless, 20th November, 1875. The present royal family of Great Britain trace their descent through Sophia, electress of Hanover, grand-daughter of James I., by her mother Elizabeth, electress palatine, and queen of Bohemia. Queen Victoria derives her descent from the Electress Sophia through George I., George II., Frederick, Prince of Wales, George III., and Edward, duke of Kent.

STUART, ARABELLA. See ARABELLA STUART.

STUART, CHARLES EDWARD. See CHARLES EDWARD STUART.

STUCCO (Italian), in architecture, a composition of white marble pulverized and mixed with plaster of lime, which being sifted and wrought up with water, is used like common plaster. Architectural and sculptural ornaments, such as fruits, flowers, garlands, festoons, &c., are made of it. In the interior of buildings stucco work is generally applied to the ceilings of apartments, the mouldings, &c. On the exterior it should be confined to those parts which are not much exposed to the rain. In some countries a stucco of common mortar and of plaster is applied to the outside of houses, and is extremely durable. Vitruvius seems to mention stucco in the second, third, and sixth chapters of the seventh book, under the name of *opus albarium* or *opus coronarium*. Immediately after the stucco is mixed it forms a very soft and ductile paste, which, however, soon hardens, and then the desired form is given to it with moulds or with a little spatula of iron. During this operation it continues to harden, and may even be cut; and at this period those parts of the ornaments are executed which demand a nice finish. In a few days it acquires the consistence of dry clay, and ultimately becomes hard like stone, and takes a beautiful polish.

STUDDING-SAILS, fine weather sails set outside the square sails; the term *scudding-sails* was formerly used. The top-mast and top-gallant studding-sails are those which are set outside the top-sails and top-gallant-sails; they have yards at the head, and are spread at the foot by booms which slide out

on the extremities of the lower and top-sail yards, and their heads or yards are hoisted up to the top-sail and top-gallant-sail yard-arms.

STUFF, in commerce, is a general name for all kinds of fabrics of gold, silver, silk, wool, hair, cotton, or thread, manufactured on the loom; of which number are velvets, brocades, mohair, taffeties, cloth, serges, &c. The term is also used more particularly to denote slight woollen articles used principally for bed-curtains, linings, and women's apparel.

STUHLWEISSENBURG, or, in Hungarian, SZÉKES FEJÉVÁR; in Slavonic, BIELIGRAD; a royal free town of Hungary, capital of a county of the same name, 80 miles south-west of Buda. It was built in the eleventh century, and during five centuries was the place where the kings of Hungary were crowned, and on that account called *Alba Regalis*. It is now declined from its former importance, and has a mean appearance, though it contains some good buildings, among which are the splendid cathedral of the Virgin Mary, the church of St. John, and the bishop's palace. It has a theological seminary, a Catholic gymnasium, a military academy, and various other educational establishments. The manufactures consist of cotton and woollen cloth, flannel, leather, knives, &c. Pop. (1890), 27,548; (1900), 30,668.

STURDY, a disease to which sheep are liable, also called *staggers* (which see).

STURGEON (*Acipenser*), a genus of Fishes belonging to the order Ganoidi, and forming the type of the family Acipenseridae or Sturionidae. The Sturgeons belong to that section of the Ganoid Fishes in which the scales are large and plate-like (Placoganoidei), and in which the skeleton is imperfectly ossified, the head being protected by bony or ganoid plates of large size. The family Sturionidae is distinguished by the fact that the bony plates cover the head, but are placed at intervals over the body. In the Sturgeon genus the notochord (which see) is persistent, and a bony spine is therefore wanting. The neural arches of the vertebrae are, however, represented in a cartilaginous state. The skeleton of a Sturgeon is shown at ICHTHYOLOGY, Pl. I., fig. 12. *a* is the anal fin, *d* the dorsal fin, *c* the caudal or tail fin, *p* pectoral fin, *v* ventral fin. The snout is conical and tapering. The mouth, which is toothless and funnel-shaped, is situated on the *under* surface of the muzzle, and is provided with tentacle-like filaments or barbules. The eyes and nostrils exist at the sides of the snout. The head is completely invested by ganoid plates, whilst on the body these plates exist in rows on the sides and back. The tail is heterocercal, or unequally lobed, and is provided with fulcra or bony spines along its upper margin. A single dorsal fin exists, and gill-filaments, or pseudo-branchiae, are developed in addition to the true gills. Spiracles or apertures for the admission of water to the gills exist on the upper aspect of the head. The opercula or gill-covers are of large size. The most familiar species of Sturgeon is the *Acipenser sturio*, which inhabits the British coasts, North Sea, and Mediterranean, and is also found in the Rhine, Seine, and Loire. It may attain a length of from 5 or 6 to 8 feet. Large specimens have been found to weigh from 200 or 300 lbs. to 400 lbs. or more. These fishes ascend rivers for the purpose of spawning, and the Volga and Danube appear to be the European rivers which are most in repute as the reproductive habitats of these fishes. The general body colour is yellow, this being lightest on the under parts. The bony scales exist in rows, numbering from thirty to thirty-five plates in each on the sides, from twelve to fifteen existing on the back. The food consists of herrings and other small fishes, and it is also said to attack the salmon. The roe, which contains an immense

number of eggs (over 3,000,000 in a single fish in some cases), forms an important article of commerce, inasmuch as when washed with white wine or vinegar, dried, salted, and pressed, it constitutes the well-known substance termed *caviare*, which in Russia especially has an immense sale and consumption. The second commodity is isinglass (which see), which is manufactured from the membrane of the sound or swimming-bladder of these fishes. This substance is prepared by the sound, when removed from the fish, being washed in fresh water, and then carefully dried. The outer coat is then peeled off, the inner coat being cut into lengths or staples, which afford the isinglass. The Sturgeon was celebrated among the ancients as well as among moderns, for we find that in the palmy days of the Roman Empire sturgeons, profusely decorated with flowers, were borne in triumph to table. In the Volga the sturgeons are captured by driving piles at close distances so as to form a barrier across the river; by this barrier the fishes are forced into an inclosure, in which they are trapped and readily seized. The Great Sturgeon or Beluga (*A. huso*) is a very famous species, often attaining a length of 12 or 15 feet and a weight of from 1000 to 1200 lbs. It occurs chiefly in the Volga and Danube, and other rivers flowing into the Caspian and Black Sea. The skin of the Beluga is employed by the Russians in the manufacture of leather. Other species are *A. ruthenus* or Sterlet (ICHTHYOLOG, Pl. I., fig. 11), and *A. stellatus*, the former a very small species, the latter about 5 feet long. The caviare prepared from the roe of the sterlet is said, like its flesh, to be of the most highly-esteemed quality. Other species of sturgeons occur in American waters, their flesh being pickled and preserved in many instances. The Spoonbill Sturgeon (*Polyodon spatula*) is an American species from the Ohio and Mississippi rivers, and possesses no plates on the body. The Shovel-fish (which see), or *Scaphiorhynchus cataphractus*, is another species of this family, occurring in North American rivers, and known by the flattened, shovel-like aspect of the mouth. This latter species possesses bony scales like the European species. Formerly any sturgeon captured in the Thames above London Bridge might be claimed by the Lord-mayor, while one caught elsewhere might be claimed by the King as a 'royal' fish. This custom doubtless arose from the high esteem in which the flesh was held by former sovereigns—Henry I. is said, indeed, to have prohibited its use at any but his own table.

STURLUSON, SNORRI, Icelandic author and politician, was born at Hvamm, in 1179, of an old noble family, who counted among their ancestors kings of Norway and Sweden. At the age of three he was placed under the care of Jon Loptson, the most learned man in Iceland, grandson of Sæmund Sigfusson, the compiler of the old Edda, and was well educated in Scandinavian history, mythology, and poetry. Left without means at the death of his father, he had the good fortune to secure the hand of a rich heiress, and he soon rendered himself popular by his bravery on the field, and eloquence in the assemblies of the people. He was elected by the unanimous voice of the people supreme judge of the island. In 1213 he composed his first poem which became widely known, a panegyric of Hako IV., king of Norway. In 1218 he paid a visit to Norway, where he was well received by Jarl Skule, who loaded him with rich presents and high dignities on the eve of his return to Iceland in 1220. In 1224, on the occasion of the division of the property of his mother, a quarrel broke out between Sturluson and his brother Sighvat, and the whole island was long

troubled by the outrages committed by the various partisans. In 1236, being forced to leave Iceland, he paid a second voyage to Norway, where he was once more warmly welcomed by Skule, now become duke. Snorri composed some poetical pieces warmly laudatory of his patron, and promising him success in the struggle going on between him and Hako V. That prince forbade Snorri to return to his native land, but the order was unheeded, and Sturluson, being informed of the decline of the power of his enemies, returned to Iceland in 1239. Hako charged Snorri's two sons-in-law, Gissur and Kolbein, to seize upon him dead or alive, a commission which they were all the more easily enabled to execute through the co-operation of other members of his family. They attacked him unexpectedly in his residence at Reikholt, and put him to death 22nd September, 1241. His principal work, which he completed about 1230, is the *Heimskringla* (Circle of the World), in which he records the lives of the legendary and historical kings of Norway down to the death of Magnus Erlingsson in 1177. It was translated into Danish by Peder Clausson, and published in Copenhagen by Olaf Worm in 1633. A recent edition is that by Jónson (Copenhagen, 1893 onwards). The work has also been translated into German, Norwegian, Swedish, Latin, and English (by S. Laing, 1844, new ed. by R. B. Anderson, four vols., 1889; by W. Morris and E. Magnússon, two vols., 1893-94). He composed numerous eulogistic poems on the princes and jarls whose courts he had visited; and wrote, it is believed, the first part (*Gylfa-Ginning*) of the *Snorra-Edda*, or Younger Edda. See EDDA.

STURNUS. See STARLING.

STUTTERING, or STAMMERING. See SPEECH.

STUTTGART, a town of Germany, capital of the kingdom of Württemberg, beautifully situated in a sort of amphitheatre a little to the west of the river Neckar, surrounded by vine-clad and wooded slopes and gardens. Except in the oldest quarter, in the centre, it presents quite a modern appearance, and has many spacious streets and squares lined with fine buildings. The principal streets run from south-west to north-east, and in this direction extends also, for a distance of about 2 miles, and nearly to Cannstatt, on the Neckar, the beautiful Schloss-Garten, or pleasure-grounds, adorned with sheets of water and groups of statuary. The Schloss, or palace, begun in 1746 but not completed till 1807, is a large edifice, consisting of a body and two wings, of an exterior by no means prepossessing but internally richly decorated and gorgeously furnished. The old palace, begun in 1500, resembles a feudal fortress, and is now occupied by officials connected with the court or government; hard by it is a monument to Schiller, with a statue by Thorwaldsen. Near it is the new Queen Olga Building (1896), in the eighteenth-century palatial style. Close to the Schloss is a large building, now containing the king's library, &c., formerly an academy which the poet Schiller attended. Other buildings are the Königsbau, with a fine colonnade, the palace of the crown-prince, the Wilhelm-palais, used by the king as a winter residence, the building for the archives and museum of natural history, the museum of the plastic arts, enlarged in 1890; and among buildings of the most recent construction the fine railway-station, the market-hall, the post-office, the mint, the royal library, several museums, the palace of justice or law-courts, the concert-rooms, the buildings for educational purposes, such as the Eberhard-Ludwigs-Gymnasium (1686), the Karlsgymnasium (1885), the real gymnasium, an old and a new real school, technical school, school of art, school of architecture

and engineering, the conservatory of music, &c. Among the churches may be mentioned the Stiftskirche, an ancient Gothic structure, with a good organ, and some interesting monuments; the Hospitalkirche, also Gothic, with a fine statue of our Saviour, by Dannecker; St. Leonard's; the fine modern church of St. John, on an admirable site; the new garrison church, in the Rhenish style of the twelfth century; and several fine churches in the suburbs. There are also an English and a Russian church, and a Jewish synagogue. The royal and public library of 432,000 vols. includes, it is said, the largest collection of Bibles in the world. The benevolent endowments are numerous. The most important manufactures are stocking-net, furniture, pianofortes, chemicals, pigments, chocolate, confectionery, carriages, coloured paper, and leather. Stuttgart is an important centre of the German publishing trade. In the immediate vicinity are alleys, parks, and gardens, affording ample means of open-air recreation; and at a short distance are various places of holiday resort, including Cannstatt, celebrated for its mineral springs. Electric lighting was introduced into the town in 1895, and electric tramways now connect it with Cannstatt and Berg. Stuttgart seems to be first mentioned in 1229, some time after which it became a residence of the counts of Württemberg. It was extended about 1449, and has since, with only a short interval, been the capital. Pop. (1885), 125,900; (1900), 176,705.

**STYE** (*hordeolum*), a little tumour on the eyelids resembling a barley-corn. The sty is strictly only a little boil which projects from the edge of the eyelids, mostly near the great angle of the eye. This little tumour is of a dark red colour, much inflamed, and a great deal more painful than might be expected, considering its small size. The latter circumstance is partly owing to the vehemence of the inflammation producing the sty, and partly to the exquisite sensibility and tension of the skin which covers the edge of the eyelids. On this account the *hordeolum* very often excites fever and restlessness in delicate, irritable constitutions: it suppurates slowly and imperfectly; and, when suppurated, has no tendency to burst. The tumour generally bursts in a few days, however, though it is generally better to puncture it. Warm-water dressings with lint and oiled silk should be applied. To prevent the reappearance of sty the patient should partake of abundance of nourishing food, and attention should be paid to the state of the bowels and the general health.

**STYLE, OLD AND NEW.** See CALENDAR and EPOCH.

**STYLITES, or PILLAR SAINTS** (from the Greek *stylos*, column; in Latin, *sancti columnares*), anchorites who, by way of penance, passed the greater part of their lives on the top of high columns. Simeon, a Syrian monk of the fifth century, invented this insane method of self-torture about 423. He lived for nine years on a column, the top of which was only about 6 feet in diameter, in the open air, near Antioch, afterwards changed it for a higher one, and at length for one 40 cubits, and only 3 feet in diameter at the top; when he slept he leaned against a sort of balustrade. On this pillar he remained twenty-eight years, till his death in 459 or 460. It appears, however, that he must have descended at times, since he cured the sick by his touch, and performed sundry other miracles, wrote epistles, and took part in political quarrels. The example of this strange being, who was canonized after his death, was imitated by many persons in Syria and Palestine, and the mania continued until the twelfth century.

**STYLOPS.** See STREPSIPTERA.

**STYPTIC**, a remedy that has the virtue of stop-

ping blood, or of closing the aperture of a wounded vessel. Oak bark decoction, gall nuts in powder or infusion, matico, and turpentine are styptics derived from the vegetable kingdom; and from the mineral are derived salts of iron, the sulphates of copper and zinc, the acetate of lead, and the nitrate of silver.

**STYRIA** (German, *Steiermark*), a duchy of Austria, bounded on the north by Upper and Lower Austria, on the east by Hungary and Croatia, on the south by Carniola, and on the west by Carinthia and Salzburg; greatest length, north to south, 124 miles; greatest breadth, east to west, 112 miles; area, 8670 square miles. It belongs decidedly to the class of alpine lands, being traversed by three distinct mountain chains, branching partly from the Noric and partly from the Carnian Alps, and attaining in their culminating points of the Grimming on the north-west, and the Eisenhut on the south-west frontiers, the respective heights of 7400 and 7646 feet. Between the mountain-ridges are numerous valleys of greater or less extent, but the only part of the surface which flattens down, so as to have somewhat the appearance of a plain, is in the south-east, where the Mur and the Drave are gradually approaching each other, preparatory to their final junction in Hungary. The whole of Styria belongs to the basin of the Danube, which drains it by means of four rivers, the Enns in the north; the Mur, which traverses the duchy centrally, first in an easterly and then in a southerly direction; the Drave, which traverses the south in an easterly direction; and the Save, which nowhere belongs wholly to Styria, but only forms part of the boundary between it and Carniola. There are a great number of small lakes embosomed among the mountains, and generally rich in natural beauty. Not much of the surface of Styria can be regarded as absolutely sterile, yet the extent of arable land is necessarily very limited, though the soil in the lower grounds is generally fertile. In many districts the vine thrives well, and some of the wines have acquired a high name. All the ordinary kinds of fruit abound, and, as auxiliary crops, hemp, flax, and the poppy are extensively cultivated. The breeds of domestic animals (milk cows excepted) are generally of an inferior description, and the management of stock is very imperfectly understood. The great sources of wealth in the country are the forests and minerals. The former cover nearly a half of the whole surface, and not only furnish immense quantities of the finest timber, in the hewing and forwarding of which to the ports of export great numbers of the inhabitants are constantly employed, but contain inexhaustible supplies of fuel for smelting furnaces. The minerals include gold, silver, lead, copper, cobalt, and zinc in limited quantities, and iron of the finest quality and in the greatest abundance. The other minerals of value are sulphur, alum, and rock salt. The raw materials thus obtained have led to the establishment of numerous manufactures, among which that of articles in iron has long taken the lead. The scythes, tools, and other cutting instruments of Styria are famous over Europe. Pop. (1900), 1,356,058, the majority of whom are of German descent, about 84 per cent being of Slavic origin, and mostly confined to the southern part of the duchy.

**STYX**, in Greek and Roman mythology the name of a river of the infernal regions. By this the gods swore when they wished to give peculiar sanctity to their oath. Styx was originally a rivulet in Arcadia, springing from a high rock near the town of Nonacria. Its water was considered poisonous to men and beasts, metals were corroded, and vessels burst to pieces by it. It is now called the Mavraneria or Black Waters, and sometimes the Drako-neria or Terrible Waters.

**SUABIA**, or **SWABIA** (German, *Schwaben*), an ancient German duchy which, after bearing the name of *Alemannia*, from its original inhabitants the *Alemanni*, changed it to *Suevia* or *Schwabenland*, in consequence of the incursion of the *Suevi*. On the division of the kingdom of the *Franks* in 843, *Suabia*, along with *Bavaria*, became as it were the nucleus of Germany, and its rulers continued for many centuries to hold a prominent place in its history. In 1376 was formed, chiefly by the union of its towns, the celebrated *Swabian League*. In 1512, when the Emperor *Maximilian I.* divided Germany into ten circles, one of them was called the circle of *Suabia*. It formed the south-west, and perhaps the fairest and most fertile portion of Germany, and was bounded north by the circles of *Franconia* and the *Rhine*, east by that of *Bavaria*, and south and west by the *Rhine*, which separated it in the former direction from *Switzerland* and in the latter from *France*. Its area was about 13,000 square miles, and its population about 2,200,000. By the *Ulm* constitution of 1563, which was maintained with a few changes till the dissolution of the German Empire, its sovereignty was shared by the *Duke of Württemberg*, the *Bishop of Augsburg*, the *Margrave of Baden*, and the *Bishop of Constance*, with a supremacy in *Austria*. It is now divided between *Württemberg*, *Baden*, *Bavaria*, *Hohenzollern*, and *Lichtenstein*. Since 1837 the former *Bavarian* circle of *Oberdonau* or *Upper Danube*, has borne the name of *Suabia-with-Neuburg* (*Schwaben-mit-Neuburg*). It consists of the principality of *Neuburg*, parts of *Upper Bavaria* (*Oberbaiern*), and the former *Swabian* episcopal and imperial cities, and has an area of 3858 square miles, and a pop. (1900) of 713,515. *Augsburg* is its capital.

**SUABIAN ALPS**. See **ALPS**, **SUABIAN**.

**SUAKIN**, a seaport of *Nubia*, on the west coast of the *Red Sea*. The principal part of the town lies on a small rocky island, but there are a number of substantial stone houses belonging to it on the mainland. The town is well fortified and contains a number of mosques and public buildings, of which the most deserving of notice are the residence of the governor (an official appointed by the *Khedive*), the custom-house, and the bazaar. The harbour is too shallow to admit large vessels. There is, however, a considerable trade, chiefly in gums, hides, butter, cattle, ivory, and ostrich feathers. It was occupied by the *British* in connection with the *Soudan* troubles, and is still held by *British* troops. Pop. about 10,000.

**SUARES, FRANCIS**, one of the most eminent scholastic and polemical writers of the *Roman Catholic Church*, was born at *Granada* on the 5th January, 1548. He was sent to study law at the *University of Salamanca*, where he was induced, along with 500 other students, by the eloquent appeal of *Ramirez*, to enter the society of *Jesuits* in 1564. At first he made little progress in his studies, and it was with great difficulty that the superiors of that order could be prevailed upon to admit him. But his untiring industry and powerful memory carried him over every difficulty, and having taken the vows at the usual time, he was employed in the educational department teaching philosophy and theology at *Valladolid*, *Rome*, *Alcala*, and *Salamanca*. His renown as a teacher having reached *Philip II.*, that monarch appointed him principal professor of divinity at the *University of Coimbra* in 1597, a position which he held until his death, which occurred at *Lisbon* in 1617. The most recent edition of his works, in twenty-eight vols. 4to, was completed in *Paris* in 1860. He took part in the famous controversy on grace and free-will, between the *Thomists* and the *Molinists*, and conceived a system called '*Congruism*,' which is a modified form of *Molinism*.

and which teaches that, while God gives to all grace sufficient for their salvation, He gives to the elect a grace so fitted to their character and circumstances that they infallibly, though voluntarily, submit to its influence. The work of his which attracted most attention is the *Defensio Catholice Fidei contra Anglicanæ Sectæ Errores*; it was written by command of *Pope Paul V.* against the oath of allegiance required by *James I.* It appeared in 1613, and gave rise to a quarrel between the *English* sovereign and *Louis XIII.* on the one side, and the pope on the other; and the work was burned publicly by the hangman both at *London* and *Paris*.

**SUBALTERN**, in the army, is a commissioned officer below the rank of captain, that is a lieutenant or sub-lieutenant.

**SUBERIC ACID** ( $C_8H_{14}O_4$ ), an acid obtained from cork (hence the name, from the Latin *suber*) by oxidation with nitric acid. This acid is more easily produced by treating commercial stearic or oleic acid with nitric acid; it forms large colourless crystals, which melt at  $140^\circ C$ . *Suberic acid* is dibasic, forming a series of *suberates* the general formula of which is  $M_2H_{12}C_8O_4$ , where *M* represents a monovalent metal.

**SUBIACO** (ancient, *Sablaqueum*), a town of Italy, in the province of *Rome*, on a height near the right bank of the *Tevere*, 34 miles east of *Rome*, in a beautiful and romantic district. It is a dull place, with dark narrow streets, but has a fine old castle, which crowns a height, and was for ages the summer residence of the popes, and a very handsome cathedral dedicated to *St. Andrew*. In the vicinity are the remains of *Nero's villa*, and near it a celebrated monastery deserving of notice as the place where the first *Italian* printing press was established. Pop. 7367.

**SUBJECT**. See **OBJECT**.

**SUB-KINGDOMS OF ANIMALS**, the name given to the great primary groups into which, in the scheme of classification, the animal kingdom is divided. These sub-kingdoms are sometimes also known as 'morphological types,' for the reason that these sub-kingdoms are constituted by a greater or less number of animals whose bodies are constructed on the same fundamental type or plan. It was the recognition of this latter fact which raised the study of modern zoology far above that of preceding eras; and the discovery of the existence of certain definite types or plans of structure in the animal world resulted from the careful pursuit of morphology (which see), or the science of structure. The recognition of this fact aided the scheme of classification in affording a sound structural basis for the arrangement of animal forms apart from mere external likenesses or differences. Thus, knowing, for example, that *Insects*, *Worms*, *Centipedes*, *Crustaceans*, *Spiders*, &c. (*Annulosa*), have their bodies (notwithstanding variations in form or detail) built up on one and the same fundamental plan, our labours in classifying these animals, or in forming an idea of their essential relations, are greatly assisted. Similarly, when we examine *Fishes*, *Reptiles*, *Birds*, and *Mammals*, including man himself, we find a single type or plan running through the various groups, and in virtue of this primary likeness we include these forms in the sub-kingdom or type of the *Vertebrata*. And we may find a similar idea of structural resemblance uniting the *Shell-fishes*, *Cuttle-fishes*, &c., to form the sub-kingdom *Mollusca*; and the *Sea-anemones*, *Zoophytes*, *Corals*, &c., to form the sub-kingdom *Cœlenterata*. The tendency amongst recent zoological systematists has been to increase the number of primary sub-divisions of the animal kingdom, and afterwards to ascertain their

varying affinities. The doctrine of descent with modification and the extension of our knowledge of embryology have shed fresh light on the subject, but there is not yet any universally accepted system of classification. The term *sub-kingdom* is being rapidly displaced by the more appropriate term *phylum*. The following is one modern arrangement of the animal kingdom, and it will serve as a type of most:—

- Phylum I. PROTOZOA (First Animals).—Amoeba, Foraminifera, Radiolarians, Infusorians, &c.  
 " II. PORIFERA (Pore-bearing Animals).—Sponges.  
 " III. COELENTERATA (Hollow-intestined Animals).—Polyps, Corals, Sea-anemones, Jelly-fishes, &c.  
 " IV. PLATYHELMINTHES (Flat-worms).—Turbellarians, Liver-flukes, Tape-worms.  
 " V. NEMERTEA.—Round Sea-worms, &c.  
 " VI. NEMATHELMINTHES.—Thread-worms.  
 " VII. ROTIFERA (Wheel-bearing Animals).—Wheel-animalcules.  
 " VIII. MOLLUSCA (Soft-bodied Animals).—Shell-fish, Cuttle-fishes, &c.  
 " IX. ANNELIDA (Ringed Animals).—Many kinds of Worms, Leeches, &c.  
 " X. SIPUNCULOIDEA.—Spoon-worms.  
 " XI. PRIAPULOIDEA.—Worm-like Animals.  
 " XII. PHORONIDEA.—Worm-like Animals.  
 " XIII. POLYZOA.—Sea-mats, Sea-mosses, &c.  
 " XIV. BRACHIOPODA.—Lamp-shells.  
 " XV. CHETOGNATHA.—Worm-like Animals.  
 " XVI. ARTHROPODA (Jointed Animals).—Insects, Myriapoda, Crustaceans, &c.  
 " XVII. ECHINODERMATA (Spiny-skinned Animals).—Star-fishes, Sea-urchins, &c.  
 " XVIII. CHORDATA (Animals with a Notochord).—Balanoglossus, Sea-squirts, and all Vertebrata (Fishes, Amphibians, Reptiles, Birds, Mammals).

In the above list the phyla are arranged in a generally ascending order, but they must not be regarded as forming a linear series. The more advanced forms of certain groups are in many ways ahead of the lower forms of groups above them in the scale, but the general type of their organization is lower. The facts of degeneration and life-history must be taken into account both in the classification and in determining the affinities of the phyla to one another. The latter can be graphically shown, so far as ascertained, by a tree-diagram (see J. A. Thomson's *Studies of Animal Life*, and Parker and Haswell's *Zoology*). All the phyla but the first are included under the term Metazoa, and those from VIII. onwards are collectively designated Coelomata, because they have a *coelom* or body-cavity. In some older classifications Vermes (Worms) was a sub-kingdom comprising a heterogeneous assemblage of worms and everything at all like them, thus including the Phyla IV.—VII., IX.—XIII., XV. Annelosa was formerly the name of a sub-kingdom equivalent to Phyla IX., XV.—XVI. taken together. Milne-Edwards' Molluscoida included Phyla XIII.—XIV. together with the Tunicata of XVIII. The Sponges (Phylum II.) were formerly included among Protozoa.

**SUB-LIEUTENANT**, in the British army, from 1871 to December, 1876, the title of the lowest rank of commissioned officers. At the former date the titles ensign (in the infantry) and cornet (in the cavalry) were abolished and sub-lieutenant substituted; at the latter date that of second lieutenant was substituted for sub-lieutenant in both cases. According to the regulations now in force a second lieutenant's commission in the British army is the first that may be obtained in the cavalry and infantry, and that only after examination.

**SUBLIMATE, CORROSIVE**. See under MERCURY.

**SUBLIMATION**, a process by which volatile substances are vaporized by heat, and again condensed in a solid form. This chemical process differs from evaporation only in being confined to Vol. XIII.

solid substances. It is usually performed either for the purpose of purifying certain substances and disengaging them from extraneous matters, or of reducing them into vapour and combining them under that form. As all fluids are volatilized by heat, and consequently capable of being separated, in most cases, from fixed matters, so various solid bodies are subjected to a similar treatment. Fluids are said to *distil*, and solids to *sublime*, though sometimes both are obtained in one and the same operation. The substance formed by the process of sublimation is called a *sublimate*. The principal subjects of this operation are volatile alkaline salts, neutral salts, composed of volatile alkali and acids, as sal-ammoniac, arsenious acid, benzoic acid, mercurial preparations, and sulphur.

**SUBLIME, THE**. This term is applied both to that quality of objects which produces a mingled feeling of pleasure and awe and to the emotion itself. That quality in objects which excites this compound emotion early attracted the attention of psychologists, the more notable of whose theories we can only briefly state here. Burke's theory is that the essence of the sublime consists in terror acting either openly or latently, and the delight caused by this terror is referred by him to those principles of our nature which he terms passions of self-preservation. Lord Kames says, 'a beautiful object placed high, appearing more agreeable than formerly, produces in the spectator a new emotion, termed the emotion of sublimity; and every other emotion resembling this emotion of elevation is called sublime'. This view is adopted by Dugald Stewart, who also holds that expanse and power are sublime by implying or suggesting elevation. Dr. Thomas Young holds that the sublime is but a larger or intenser form of the beautiful. Payne Knight suggests that the sublime is the effect of the influence of mental energy exciting a sympathetic energy within us. Blair considers that might, power, or force is the cause. Sublimity, according to Sir William Hamilton, requires magnitude as its fundamental principle, and exists in three forms—space, time, and power. Various theories have also been propounded regarding the emotion. It has been called by the followers of Burke a sense of security in circumstances of terror or peril. According to Hamilton it is a mingled feeling of pleasure and pain—pleasure in the consciousness of strong energy, pain in the consciousness that this energy is vain. Many other philosophers have attempted to analyse sublimity. The oldest extant work on the subject is that of Longinus, a distinguished philosopher of the third century of our era. His work is in Greek and bears the title *Peri Hypsous*, but it deals rather with elevation or loftiness in speech and writing than with the nature of the sublime in general. In his Critique of the Faculty of Judgment Kant deals with the question in a masterly way. The pleasure experienced in the contemplation of the sublime he regards as derived from its resistance to the interest of the senses. Many natural objects may be called beautiful, but in strictness none can be called sublime; for the basis of the sublime is within us and is, as it were, projected upon nature. He distinguishes between the mathematically sublime, our sense of which is based upon our finding all sensible standards of measurement incommensurate with the ideas of the reason; and the dynamically sublime, which rests on our consciousness of the great power of nature while feeling that it is not a power to which we must yield. Kant's views were further developed by Schiller, Schelling, and other philosophers, and were opposed by Herder. Hegel also contributed to the elucidation of this difficult question.

**SUBLIME PORTE.** See **PORTE, OTTOMAN**, and **CONSTANTINOPLE**.

**SUBMARINE CABLE**, a rope of wires and insulating materials laid along the bed of a sea or ocean through which telegraphic messages are transmitted. The conducting portion of such cables is made of the very purest copper, and consists of a wire or a number of wires twisted into a strand, forming what is called the *core*. For the purpose of insulating the core it may be thoroughly covered with a pitchy mixture called Chatterton's compound, and then further covered with alternate coatings of gutta-percha and Chatterton's compound. After the diameter has in this way been about doubled, the core is usually lapped with wet tanned hemp, and outside this a twisted skin of iron wires, which have separately been covered with a pitched lapping of Manila yarn, is formed round it. It is not usual to have a single wire as conductor, owing to the risk of breakage. As early as 1840 a system of submarine telegraphs had been proposed by Wheatstone, but it was not until 1850 that the first attempt was made, and that but for a short distance—between Dover and Calais. This cable only lasted a few hours, owing to friction against the rocks, but communication was re-established not long after. In 1857 an attempt was made with a British and a United States ship to lay a cable in the bed of the Atlantic, but it failed, the cable giving way owing to a strain being put on the paying-out machinery by the sudden dip of the sea-bottom westward from the Irish coast. In 1858 the same two ships, each with one-half of the cable on board, met in mid-ocean, effected a splice, and steering in opposite directions, ultimately succeeded in laying the cable. After some time the transmitting power of the cable grew more and more feeble, and at last died out altogether. In 1865 another unsuccessful attempt was made, but in the following year a fresh cable was laid by the *Great Eastern*, and the cable of 1865 was recovered and completed. There are now some ten cables from Britain and two from France connecting Europe with North America. Britain communicates with Europe by fifteen or sixteen cables, and with Ireland by eight; Japan is brought into communication with the outer world by cables to Shanghai and Vladivostok; and a cable stretching from Singapore to Java, and another from Java (Banjuwangi) to Port Darwin connect Australia and through it New Zealand with the telegraph system of the world. A cable from Vancouver by way of Fanning Island, Fiji, and Norfolk Island connects Canada with Australia and New Zealand. The length of the 1866 cable between Ireland and America is 2370 miles. Among the longest submarine cables are those connecting Brest with St. Pierre (3100 miles), Penzance with Nova Scotia (2920), Ireland with Nova Scotia, Ireland with Newfoundland.

An important difficulty in connection with submarine telegraphy consists in the resistance due to induction between the inner core and the outer iron wires or the surrounding water. This resistance becomes very considerable when the line of cable is long. The difficulty is removed when Thomson's (Kelvin's) mirror galvanometer is employed to receive the signal. This instrument is sensitive to the slightest pulsations of electricity in the cable, and signals are transmitted quickly when the cable is discharged after each signal by momentarily connecting it with the opposite pole of the battery. Another instrument much used for recording signals sent through submarine cables is Thomson's siphon recorder. See **TELEGRAPH (ELECTRIC)**.

**SUBMARINE VESSELS.** See **WAR VESSELS**.  
**SUBORNATION.** See **PERJURY**.

**SUBPCENA**, in English law, is a writ issued in the king's name, directed to a witness, commanding him to appear at the court to testify what he knows in the case therein described, pending in the court, under a penalty (*sub pana*) of £100. Should the court wish to examine any books or papers connected with the case in possession of the witness, a clause is inserted in the writ instructing him to bring them with him, and the writ is then called a *subpcena duces tecum*. An action of damages lies against the party disobeying this writ, unless he has a good legal excuse, such as dangerous illness; but the *subpcena* must have been served a sufficient time beforehand to enable him to arrange his affairs in contemplation of his absence, and to reach the court if at a distance; his travelling expenses must have also been paid beforehand.

**SUBSIDY**, a term used in various senses. It may signify the pecuniary assistance afforded, according to treaty, by one government to another, frequently in consideration of its furnishing a certain number of troops. In England the term was formerly applied to an aid or tax granted to the crown for the urgent occasions of the kingdom, and was levied on every subject of ability according to the value of his lands or goods. Subsidies began to fall out of use after the Revolution; it was necessary to procure larger funds than had been granted during the reign of the Stuarts, and these were raised by a land tax, customs duties, the excise, &c.

**SUBSTANCE** (*substantia*), in a philosophical sense, is contradistinguished from *accident*, and signifies that which exists independently and unchangeably; whilst *accident* denotes the changeable phenomena in substance, whether these phenomena are necessary or casual, in which latter case they are called accidents in a narrower sense. Substance itself is the essence which is capable of these phenomena, and in spite of any changes in the phenomena remains the same. Some schoolmen gave the name of substance to that in which exists our ideal of perfection; others to a thing which exists through itself and for itself. The fundamental doctrine of Descartes' philosophical system was the essential difference between spirit or thinking substance, and matter or extended substance. These two stand for us in absolute opposition, and are only reconciled and harmonized through the Infinite Being of God. Spinoza rejected the dualism of Descartes, and regarded thought and extension as attributes of one absolute substance, which he called God. Leibnitz calls substance that which contains in itself the cause of its changes. In natural science and in common life, substance is used to designate material things, especially simple inorganic bodies and the fundamental constituents of organic bodies, for example, a liquid substance. But every substance which falls within the scope of our observation, if we understand by substance that which is unchangeable in its phenomena, is only a relative one; that is, is such only in respect to some others, and is not unconditionally independent, but must be conceived dependent upon one original cause of things. In contradistinction to the *relative* substance, therefore, we may speak of *absolute* substance as the one original essence of all things; and the relation of the latter to the former has been variously considered.

**SUBSTANTIVE.** See **NOUN**.

**SUBWAYS**, tunnels cut for various purposes beneath the public streets of large towns. The overcrowded state of the streets of London made conveyance from one part of the metropolis to another a matter of some danger and delay, and it was suggested many years ago by the late Charles Pearson,

solidator to the city corporation, that an underground railway would relieve the streets of much of the traffic. It was some time before the idea came to be looked upon with favour by practical men, but at last, about 1855, a company was formed to construct an underground railway, to which the corporation subscribed £200,000, and this sum, together with the aid of the Great Western and Great Northern Railway Companies enabled the company to begin work with some prospect of success. The engineering difficulties were great. The workmen had to burrow for 3 or 4 miles underground, streets and houses were undermined, and the work had to be carried on in the midst of water and gas pipes, sewers, mains, and ditches. At last, however, the work was accomplished, and the Metropolitan (or, as it is most commonly called, the Underground) Railway was opened to the public in January, 1863. Subways were latterly constructed by the metropolitan board of works beneath most of the new streets opened in London, with the view of doing away with the nuisances caused by the stoppage of traffic when the pavement is torn up to allow a gas or water main to be laid or repaired. The first of these subways was constructed under a new street extending from Covent Garden Market to St. Martin's Lane, opened in 1861. This subway is an arched passage, 12 feet broad and nearly 7 feet high, built of solid and carefully finished brickwork; side passages, each 4 feet high by 3 feet wide, lead to the cellars of the dwellings lining the street. In this subway are laid the gas and water mains and telegraph wires, the side passages conveying the two former necessities direct into the cellars. Repairs can be carried on in it with the greatest ease, and there are side entrances to permit the access of men, pipes, and other materials. The drains from the houses are formed of strong stoneware pipes, passing at a rather steep incline beneath the subway into the main sewer, which is placed below the floor of the subway in the centre, not so deep, however, but that it can be instantly opened. The Thames Northern Embankment has a subway for the Metropolitan District Railway, another for the great low-level sewer, and another for gas and water pipes. Subways of a similar nature have been formed in some of the more important towns in the north of England and elsewhere. Glasgow has a subway for passenger traffic within the limits of the busiest part of the city. It is operated by means of a cable, and in this respect is perhaps unique.

**SUCCESSION, APOSTOLICAL**, is the transmission, through the episcopate, of the power and authority committed by Christ to his apostles for the guidance and government of the church. According to this view it is only the regularly-ordained priests who have a divine commission to preach the gospel, administer the sacraments, and guide the church; and it is maintained by many believers in the doctrine of apostolical succession that those Christian sects which have no regular succession (having separated from the Roman Church without retaining ministers regularly ordained, that is, almost all Protestant sects except the Anglican Church) have, strictly speaking, neither church nor sacraments, seeing they have no apostolical authority. In the Church of England this doctrine was first clearly and zealously maintained by Laud and his followers. At the present day it is chiefly the members of the High Church party who regard the doctrine as of much importance. See **BISHOPS** and **ORDINATION**.

**SUCCESSION DUTY.** By 16 and 17 Vict. c. 51 certain duties are charged upon all property, whether real or personal, passing by the decease of persons dying after 19th May, 1853. The interest of a successor in real property is considered as an annuity on

his life, and tables are appended to the act for valuing the annuity. To a child or parent, or any lineal descendant or ancestor of the deceased, the duty chargeable is *one* per cent; to a brother or sister, or their descendants, *three* per cent; to an uncle or aunt, or their descendants, *five* per cent; to a great uncle or great aunt, or their descendants *six* per cent; to any other relation or any stranger in blood, *ten* per cent. Where the whole sum, passing from the deceased to his successors, does not exceed £100, no duty is to be charged, and no duty is to be payable on any succession under £20. Persons (such as husband or wife of the deceased) who would not have been charged for legacy duty, are exempted from the duties imposed by the act. All the property of a deceased person is first liable to *estate duty* (by act of 1894), and then to legacy and succession duties. The subject is rather intricate, and in practice a lawyer is usually consulted in a case of succession.

**SUCCESSION WARS** are wars which arise from claims for the possession of the crown on the occasion of a sovereign dying without undisputed legal heirs. In modern European history the most important of these struggles were those of the Spanish succession (1700–1713), and of the Austrian succession (1740–1748).

**WAR OF THE SPANISH SUCCESSION.**—Shortly before the death of Charles II. of Spain, without issue or collateral male heir, several competitors laid claim to the throne, the two principal being the dauphin of France, son of Charles's elder sister; and the Emperor Leopold, who first claimed as male representative of the younger branch of the house of Austria, being descended from Ferdinand, second son of Philip and Joanna of Castile, though he afterwards withdrew this claim and substituted another in right of his mother, Mary Ann, daughter of Philip III. of Spain. The other leading powers, Britain, Germany, and Holland, were naturally deeply interested in the settlement of this question, for the union of either France or Austria with Spain, which at that time ruled over the Netherlands, the Milanese, Naples, and Sicily, and vast territories in America, would have seriously endangered the balance of power in Europe. After much negotiation which had little result, Louis XIV. put forward his second grandson, Philip of Anjou, as the representative of the French claim, and Leopold nominated his second son Charles as his substitute, both parties solemnly promising that Spain should never be incorporated with their respective dominions. Charles of Spain's second consort, Mary Ann of Neuburg, being a sister of the empress, naturally promoted the views of Leopold; in which, however, she was opposed by the Count d'Harcourt, a clever diplomatist sent by Louis to Madrid, who by his popular manners, winning address, and partly it is said by bribery, conciliated many of the nobles and grandees, whom the maladroitness of the queen had alienated from her party. The French ambassador also worked upon the timid mind of Charles by menaces, plainly intimating a resort to force if the rights of the children of France should be superseded. By these means the King of Spain was induced to recognize Philip of Anjou as his heir, 2d October, 1700. On the 1st November the king died, and the Junta immediately caused Philip to be proclaimed at Madrid. The young king entered his capital on the 18th February, where he was received with the acclamations of the people. All the European provinces and all the American possessions of the Spanish empire recognized the new monarch, nor was his title at first disputed by the greater part of the European powers. If Louis had now acted with moderation and judgment he might have prevented the great coalition that was at length formed against him; but his measures were

such as to excite suspicion, while they offended by their arrogance. On the death of James II. of England, the French king recognized his son the old Pretender as James III.; the new works which the French were constructing on the Dutch frontier alarmed the States-general, and on the 15th May, 1702, England and Holland allied themselves with Austria, and declared war against Louis XIV. and the 'usurper' of Spain. The contest had, however, been already opened by Austria unaided. Prince Eugene descended into the plains of Verona at the head of 25,000 men about the end of May, 1701, defeated the French under Catinat at Carpi (9th July), and under Villeroi, at Chiari (September), but this severe fighting had no adequate result. In the following summer Marlborough led an Anglo-Dutch-German army into Belgium, and reduced one by one the French fortresses on the Maas; the German States, which, with the exception of Bavaria and Cologne, had been gained by Leopold, sent out an army under the Margrave of Baden, which crossed the Rhine and captured Landau. Early in September the Elector of Bavaria raised an army and endeavoured to effect a junction with Villars, who was sent by Louis to co-operate with him, but they were both kept in check by the Margrave of Baden. In 1703 Marlborough, whose actions were hampered by the delegates of the States-general, confined himself to reducing the strongholds held by the French in the Low Countries. In Germany the Elector of Bavaria drove the Austro-German armies out of his dominions, and formed a junction with Villars. The latter advised a rapid march upon Vienna, which might have then been easily captured, but the elector preferred to attack the Tyrol, where the French general Vendôme, with half the army of Italy, was to meet him. The Tyrolese, however, rose against the Bavarians and compelled the elector to retreat before Vendôme could join him. The elector again united his forces with those of Villars, and inflicted a severe defeat on the Imperialists at Hochstedt (20th September); but many misunderstandings arose between the two commanders, and Villars in disgust obtained his recall. In the following year Eugene and Marlborough joined their forces at Donauwörth on the Danube, and coming up with the Franco-Bavarian army under Tallard, Marsin, and the elector, at Blenheim inflicted upon it a severe defeat, 13th August. In consequence of this decisive victory the French had to recross the Rhine and evacuate all Germany. On the 4th of the same month Gibraltar had been taken in a few hours by a party of English sailors. The campaigns of Marlborough in the Netherlands and of Eugene in Italy in 1705 have no feature of interest. In Spain the English under the Earl of Peterborough captured Barcelona, and had the archduke proclaimed king as Charles III. The year 1706 was disastrous to the French arms. In Italy the united forces of Eugene and the Duke of Savoy fell upon the French while they were besieging Turin, and gained a complete victory, all the siege artillery falling into their hands (7th September). All Lombardy submitted to the Imperialists, and Charles III. was proclaimed at Milan. In the Netherlands Marlborough routed the French under Villeroi at Ramillies (23d May), and was prevented from besieging Dunkirk only by the jealousy of the Dutch. In 1707 an Anglo-Portuguese army under the Earl of Galway entered Spain, but was met by a much superior Franco-Spanish force under the Duke of Berwick at Almanza, and completely defeated (25th April). In Southern Italy the whole kingdom of Naples submitted to a small Imperial army under Daun. Nothing of importance took place in Netherlands or Germany. Eugene and the Duke of Savoy,

penetrating into France by the Maritime Alps and Nice, appeared before Toulon towards the end of July, but the approach of some strong French divisions compelled them to retreat with considerable loss. In the following year Marlborough and Eugene, according to a fixed arrangement, reunited their forces in the Low Countries, and coming up with the French under the Duke of Burgundy and Vendôme at Oudenarde inflicted on them a severe defeat (11th July). The allies then entered French Flanders, and laid siege to Lille its capital, which capitulated 22d October. On the Rhine both sides remained on the defensive. In Spain Charles III. was compelled to shut himself up in Barcelona. The island of Sardinia submitted to Admiral Lake in August, and in the following month Minorca was captured by Lake and General Stanhope. The length and ill success of the war had now begun to tell with fatal effect upon France. The funds required for the equipment and support of the armies were raised by ruinous loans, injudicious and vexatious taxes, the forestalment of future revenue and the issue of paper money and a debased coinage. A severe winter destroyed the corn, vines, and fruit-trees, and the dearth and famine which ensued produced discontent and sedition. Louis XIV. sued for peace, offering to give up, in the name of his grandson, the whole of the Spanish succession, and to restore Strassburg to the empire; but the allies looked upon these overtures as mere tricks to gain time, and rejected them. Both sides now made extraordinary preparations for renewing the struggle. Villars was sent into Flanders with an army of nearly 100,000 men to oppose Marlborough and Eugene, whose combined strength was slightly superior. After capturing Tournai, the allies proceeded to invest Mons. For this purpose they had to attack Villars in a strongly-fortified position at Malplaquet, from which they succeeded in driving him, but not without suffering enormous loss (11th September, 1709). After some more fighting, besieging, and negotiating, the death of the emperor, Joseph I., son and successor of Leopold, without male issue, leaving his crown to his brother Charles, changed the whole aspect of affairs. The British naturally thought that if Charles became undisputed sovereign of Spain and her dependencies, the very evil of an almost universal monarchy would be again established, the prevention of which had been the chief cause for taking up arms against Philip V. A new Tory ministry unfavourable to Marlborough having come into power, private preliminaries of peace were signed between France and England on the 8th October, 1811. Eugene, however, continued the war aided by the Dutch, and was pushing steadily forward on Paris, but the defeat and capture of the British contingent under the Earl of Albemarle at Denain by Villars (24th July, 1712) so weakened his forces that he was compelled to retreat. This defeat greatly modified the views of the Dutch, and the English government persuaded the States-general to moderate their demands and come to terms with France. On the 11th April, 1713, the Dutch plenipotentiaries signed a treaty of peace with France, their example being immediately followed by Prussia, Savoy, and Portugal. Forsaken by all his allies, the Emperor Charles was reluctantly compelled to sign a treaty at Baden, 7th September, 1714, in which he recognized Philip V. as king of Spain. See **UTRECHT (PEACE OF)**.

**WAR OF THE AUSTRIAN SUCCESSION.**—On the extinction of the male line of the house of Hapsburg, by the death of Charles VI. (20th October, 1740), his eldest daughter, Maria Theresa, in terms of the Pragmatic Sanction (which see) claimed the whole of his dominions, and at once assumed the govern-

ment, with the title of Queen of Hungary and Bohemia. The announcement of her accession was answered by England, Russia, Prussia, and the States-general with assurances of friendship and goodwill. France returned an evasive answer; Charles Albert, elector of Bavaria, refused to acknowledge the Queen of Hungary until his pretensions to the Austrian succession were examined and decided. He appealed to two ancient documents—the marriage contract between Albert V. duke of Bavaria and Anne, daughter of the Emperor Ferdinand I., and the testament of that monarch; and he contended that by these two deeds the succession was assured to Anne and her descendants in default of *male heirs*, the issue of the archdukes her brothers. Maria Theresa, however, having called together the foreign ministers at her court caused the testament to be read before them, when it turned out that it spoke not of the extinction of the male issue of Ferdinand's sons, but of their *legitimate* issue. The first blow against the young queen came not, however, from any claimants of her inheritance, but from a sovereign who had already acknowledged her right. This was Frederick II. of Prussia, who, in the middle of December, 1740, invaded Silesia at the head of 30,000 men, to sustain an old family claim on four duchies in that province. On the condition that Maria Theresa would cede to him all Silesia he promised a close alliance with himself, in conjunction with the Maritime powers and Russia, his assistance in upholding the Pragmatic Sanction, his vote for her husband as emperor, and an advance of two million thalers, but the high-spirited queen, determined not to begin her reign by dismembering her dominions, gave these offers a flat refusal. Owing to an exhausted treasury and a disorganized army, all Silesia, with the exception of Glogau, Brieg, and a few other places, was overrun by the end of January, 1741. A severe winter hindered further operations for a time, but on 9th March the Prussians took Glogau, and pushed on towards Jägerndorf. The advance of three bodies of Austrian troops from different quarters now threatened to hem in the Prussians, and to maintain his communications with Lower Silesia, Frederick had to risk a battle at Mollwitz, in which his forces were victorious, though he himself deserted them at the first charge (10th April). This victory called into action those powers that had postponed their schemes till they had learned the issue of Frederick's attempt. France put herself at the head of a confederacy of all the claimants to the Austrian dominions, the principal among whom were the Electors of Bavaria and Saxony, sons-in-law of the Emperor Joseph I.; Philip V. of Spain; Charles-Emmanuel of Sardinia, who claimed the Milanese, and Frederick II. of Prussia, who demanded all Silesia. To this formidable coalition Austria could oppose only a few allies. England granted her an annual subsidy of £300,000; the Dutch were arming in her favour; the mixed population of Hungary and the peasants of the Tyrol rose almost in a mass. Towards the end of June the Bavarians entered the Austrian territory, overran Bohemia, and being joined by the French under Belleisle, occupied Linz, the capital of Upper Austria, without striking a blow. Alarmed by this invasion Maria Theresa bought the neutrality of her most formidable foe Prussia, by the cession of Silesia and the county of Glatz. On the 24th January, 1742, the Elector of Bavaria was unanimously chosen emperor, with the title of Charles VII., but at the moment when he had attained the object of his ambition his fortune began to turn. Khevenhüller at the head of one Austrian army, advanced up the valley of the Danube, captured a Franco-Bavarian

corps 12,000 strong in Linz (24th January), invaded Bavaria, and on the 18th February took possession of Munich, only a day or two after Charles VII.'s election to the imperial throne had been celebrated there. Another Austrian army under the Grand-duke of Tuscany kept the French in check in Bohemia. The successes of Austria alarmed Frederick II. for the security of his new acquisitions, and he suddenly broke the treaty, poured his forces upon Moravia and Upper Austria, and defeated the Austrians under Prince Charles of Lorraine at Cressau (17th May). But Frederick was not inclined to push his victory farther, he once more made peace with Austria (11th June), and his example was followed by the Elector of Saxony. In consequence of these arrangements the French under Belleisle, left without the co-operation of the Saxons, were forced by the manoeuvres of Charles of Lorraine to shut themselves up in Prague, where Maillebois, with the French army, was defeated in endeavouring to relieve them. Only 12,000 of the 60,000 men whom Belleisle led into the campaign succeeded in escaping from Prague and making their way into France early in 1743. In the May of that year Bavaria was again occupied by the Austrians under Prince Charles and Khevenhüller. An Anglo-German army of 40,000, under the Earl of Stair, crossed the Mass and Rhine in March and April, in order to cut off the Bavarian army from France, and coming up with the French under Marshal Noailles at Dettingen completely routed them (27th June), but did not know how to profit by their victory, and nothing was done during the remainder of the campaign. The year 1744 brings with it a new phase of the war; France and Britain, which up till this time had been engaged in the struggle merely as allies, declared war against each other. In February a descent was attempted on England, but Admiral Norris, aided by a tremendous storm, proved too strong for the French fleet, and the English proceeded to destroy gradually the shipping of the French, and that of their allies, the Spaniards. As a compensation Marshal Saxe conducted a defensive campaign in the Netherlands, which covered the French arms with glory. Meanwhile the successes of Austria on the Rhine, and the ill-concealed regrets of Maria Theresa for the loss of Silesia, again alarmed Frederick for his possession of that province. He accordingly entered into an alliance known as the Union of Frankfurt (22d May), with the emperor, the elector palatine, and the King of Sweden, as Landgrave of Hesse-Cassel; a secret treaty was also signed with France, 5th June. A Prussian army of 80,000 men was at once poured into Bohemia, which for a time carried all before it, capturing the capital Prague after a siege of six days, 16th September. The junction of a superior Austro-Saxon force, however, and the hostile attitude assumed by the Bohemian population compelled Frederick to quit the kingdom with considerable loss. To avenge this attempt upon Bohemia the Austro-Hungarians broke into Upper Silesia and Glatz, from which the Prussians were almost totally expelled before the end of the year; but before the spring of 1745 the territory was again occupied by the Prussians. Frederick's unsuccessful invasion of Bohemia had proved of service to the emperor, as it compelled the Austrians to return from Alsace, and thus allowed time to recover his electorate of Bavaria. The Italian campaign of 1744 was unfavourable to the Austrians. In the preceding year they had driven the Spaniards almost to the Neapolitan frontiers, and seemed to threaten an invasion of Naples itself. To avert such a catastrophe Don Carlos joined the Spaniards with his forces, and enabled them to drive the Austrians and Sardinians

out of the Papal territories towards the Po. On the 30th January, 1745, died the Emperor Charles VII., an unexpected event, which changed the face of affairs. He was succeeded in the Bavarian electorate by his son, Maximilian Joseph, then only seventeen years of age. Being too young to make any pretensions to the imperial crown, and the war going so unsuccessfully for his cause, his subjects loudly demanded a termination of their miseries, and he accordingly concluded a peace with Austria, 22d April. The King of Prussia having now no other ally but France, remained on the defensive for a considerable part of this year. He intrenched himself near Jauernik, on the Bohemian frontier, and awaited the approach of the Austro-Saxons. Prince Charles, who commanded them, advanced by Landshut into the plains of Hohenfriedberg, where he was unexpectedly attacked and defeated by Frederick, near Striegau (4th June). Charles retreated into Bohemia followed by the Prussians, and another battle was fought at Storr, which again went against the Austrians (20th September). About this time the Queen of Hungary conceived the bold plan of detaching 10,000 men from the army of the Rhine, who, supported by the Saxons, were to march upon Berlin; while Prince Charles was to attack the Prussian king in his winter quarters in Silesia with another army. Hearing of this project, Frederick determined to anticipate it by an advance into Saxony. About the end of November he entered Lusatia, reduced that province, and marched upon Dresden. The King of Poland (the Elector of Saxony) fled to Prague, while Frederick's veteran lieutenant Leopold of Dessau entering Saxony by way of Halle, took Leipzig and Meissen, defeated the Saxon army at Kesseldorf (15th December) and joined the king before Dresden, which capitulated 18th December. Maria Theresa was now compelled to listen to the appeals of the Elector of Saxony, as well as to the British cabinet, which threatened to withdraw its subsidy unless she made peace with Prussia. Frederick was willing to come to terms, feeling that he could not depend on the assistance of France, and that he was unequal to another campaign, his money being almost exhausted. The Peace of Dresden (25th December) assured him of Silesia and Glatz, the cession of which was guaranteed by England, and of an indemnity of 1,000,000 dollars from Saxony. As Elector of Brandenburg Frederick adhered to the election of Maria Theresa's husband as emperor, with the title of Francis I. Meanwhile the French under Marshal Saxe carried all before them in Flanders. The battle of Fontenoy, gained over the Duke of Cumberland and Field-Marshal Königseck (11th May), was followed by the capture of Tournai, Ghent, Bruges, Oudenarde, Nieuport, and Ath. Little was done on the side of the Rhine. The Italian campaign of this year was unfavourable to the Austrians. The Spanish-Neapolitan army, now joined by the Genoese and Modenese, and numbering in all 70,000 men, overran the whole of Lombardy and the greater part of Sardinia, compelling the king to seek refuge under the walls of his capital; but in the following year (1746) the battle of Piacenza, gained by the Austro-Sardinians over the Franco-Spanish forces (16th June), compelled the latter to relinquish all their conquests and recross the Alps. On the 9th July died Philip V. of Spain, and was succeeded by Ferdinand VI., one of whose first steps was to recall his forces from Italy, and the French, unable to hold out against their enemies, retreated across the Var, which left Genoa at the mercy of the Austrians, 6th September. Marshal Saxe continued his career of conquest in Flanders, and in 1747 he entered and overran Dutch Flanders, defeated the

Duke of Cumberland at Lauffeld (2d July), while his chief engineer Count Löwendahl captured, after a siege of two months, the important fortress of Bergen-op-zoom, deemed by the Dutch impregnable. Meanwhile it was evident that the war was drawing to a close. Though great preparations were being made for another campaign, negotiations had been going on during the winter, and a congress had been appointed to meet at Aix-la-Chapelle, whose first conference took place 24th April, 1748. Great Britain and Holland were weary of the war; France and Spain were almost exhausted, and preliminaries of peace were signed between these powers (30th April); Austria thus deserted by her allies grudgingly consented to sign on the 18th May; and the definite Treaty of Aix-la-Chapelle was signed by the French, English, and Dutch ministers on 18th October, and in a few days after by those of Spain, Austria, Genoa and Modena. See AIX-LA-CHAPELLE (TREATIES OF); also AUSTRIA, FREDERICK II., and MARIA THERESA.

**SUCCINIC ACID**, an acid obtained by the distillation of amber. By adding one twelfth part of sulphuric acid, diluted with an equal weight of water, the yield of acid is much increased. The acid, being dissolved in hot water, and filtered, is to be saturated with potash or soda and boiled with charcoal. The solution being filtered, nitrate of lead is added; whence results an insoluble succinate of lead; from which, by digestion in the equivalent quantity of sulphuric acid, pure succinic acid is separated. It is in white transparent crystals, which possess a sharp taste, and powerfully redden tincture of turnsole. It is soluble in both alcohol and water. Succinic acid has the formula  $C_4H_4O_4$ ; it is a dibasic acid, forming salts the general formulae of which are  $MHC_4H_4O_4$  and  $M_2C_4H_4O_4$ , where M = a monovalent metal. The succinates of potash and ammonia are crystallizable and deliquescent. That of soda does not attract moisture. The succinate of ammonia is useful in analysis to separate oxide of iron.

**SUCHET**, LOUIS GABRIEL, Duke of Albufera, Marshal of France, born at Lyons in 1770, entered the military service at an early age (1790), and passed rapidly through the inferior ranks. In 1796 he was attached to the army of Italy, and attracted the notice of General Bonaparte, by his courage, boldness, and caution. He then served with distinction under Masséna and Joubert, and was one of the most active and successful of Napoleon's generals in the campaigns of 1805 and 1806. In 1808 he received the command of a division in Spain, and was almost constantly victorious till after the battle of Vittoria. His brilliant services in that country obtained him the marshal's staff, and the title of duke. After the restoration Suchet was created peer of France. Having accepted, under Napoleon, a command during the hundred days, he was deprived of his seat on the second restoration, but readmitted in 1819. He died in 1826.

**SUCKER** and **SUCKING-FISH**, a name applied popularly to the Remora (which see); to the Cyclopterus or Lump-sucker (which see); and also to the fishes belonging to the Teleostean genus *Liparis*, which is nearly allied to the Lump-suckers, and which is included in the family Discoboli. The best-known forms are Montague's Sucker (*Liparis Montagu*) and the Common Sucker or Sea-small (*L. vulgaris*). These fishes possess a single dorsal fin only, and as in other members of the group to which they belong the united ventral fins form a sucking-disc, by means of which they adhere to stones and other fixed objects. They are small fishes, 3 or 4 inches long. The Common Sea-sucker is sometimes named the 'Unctuous Sucker,' from the quantity of

mucus which, like the *Eels*, it secretes, and with which it covers its body.

**SUCKLING**, **SIR JOHN**, poet, was born at Whitchurch in Twickenham parish, Middlesex, in Feb. 1609. He came of an ancient Norfolk family, and his father, Sir John Suckling, held important offices under James I. His mother was a sister of Lionel Cranfield, whom James in 1622 created Earl of Middlesex. He entered Trinity College, Cambridge, in 1623, but left without taking a degree. By the death of his father in 1627 he inherited valuable estates, and in 1628 he set out on a tour in France and Italy. Returning to England in 1630, he was knighted by Charles I., and in the following year he went to the Continent as one of a force raised by the Marquis of Hamilton for service under Gustavus Adolphus. In 1632 he was again in England, where he lived the fast life common among the young courtiers. About 1637 he began to be known as an author, and next year his tragic-comedy *Aglaure* was published. He raised and equipped a hundred horse at a cost of £12,000 to serve in the Scottish campaign of 1639, and his share in the retreat from Kelso exposed him to much ridicule. In 1641 he proposed to Charles a plan for obtaining the control of the army. This plan was disclosed to the parliamentary leaders by one of Suckling's friends about the same time as the unsuccessful attempt of the king's agents to liberate Strafford from the Tower, and in consequence Suckling had to flee to Paris. He seems to have poisoned himself in that city about the middle of 1642. All Suckling's really important works were collected in a volume entitled *Fragmenta Aurea*, published in 1646. They include the three plays *Aglaure*, *The Goblins*, and *Brennoralt*, a tract on Socinianism, several letters, and non-dramatic poems. Of the poems the best known now are: *A Session of the Poets*, *The Ballad upon a Wedding*, and the short lyric *I Prithee Send Me Back My Heart*. The beautiful lyric beginning *Why so Pale and Wan, Fond Lover?* forms part of *Aglaure*. The third edition of the *Fragmenta* contained an unfinished tragedy entitled *The Sad One*. See the life in A. I. Suckling's *Selections* (1836), and W. C. Hazlitt's edition of *The Poems, Plays, and other Remains* (two vols., 1874).

**SUCRE**. See **CHUQUISACA**.

**SUCRE**, **ANTONIO JOSÉ DE**, was born in 1793 at Cumana in Venezuela. He entered the insurrectionary army in 1811, and in 1819 he had attained the rank of brigadier-general. With the assistance of the Peruvians under Santa Cruz he gained the decisive victory of Pichincha, May 24, 1822, which was immediately followed by the capitulation of Quito. He totally routed the Spanish forces in the battle of Ayacucho, December 9, 1824, the most brilliant ever fought in South America. (See **AYACUCHO**, **BATTLE OF**.) Sucre promptly followed up this glorious victory, and his troops entered Cuzco on the 12th of December in triumph. Upper Peru was soon entirely liberated and turned into a republic called Bolivia, of which Sucre was elected president in 1826. An insurrection broke out in 1828, and Sucre was driven from the country; but he returned at the head of a Colombian army and reinstated himself. He was assassinated in the neighbourhood of Panto in June, 1830.

**SUCTORIA**, a name applied in zoology to various groups of animals characterized by having the mouth adapted for sucking. The leeches, now usually known as *Hirudinea*, were formerly classified under this name. (See **LEECH**.) Amongst insects the fleas have been included in a group known by the name *Suctoria*, and formerly the term was applied to an order of infusorians. Lampreys and similar fishes

were also at one time known by this name, which has likewise been used in the classification of crustaceans and flat-worms. In all these cases the term is no longer used.

**SUDAN**. See **SOUDAN**.

**SUDBURY**, a municipal borough of England, in the county of Suffolk, 18 miles west of Ipswich, on the left bank of the Stour. It is neat, clean, and well built, and has three parish churches, all spacious structures, principally of Perpendicular work; a Roman Catholic and several dissenting places of worship; a grammar-school, large church schools, board schools, and several charities; a town-hall, corn-exchange, and an hospital; a literary and mechanics' institution; manufactures of silk, velvet, and cocoa-nut matting, extensive lime and brick works, and a considerable trade in coal and agricultural produce by the Stour. Pop. (1891), 7059; (1901), 7108.

**SUDBURY**, a town of Canada, in Nipissing district, Ontario, situated to the north of Georgian Bay, on the Canadian-Pacific Railway, 443 miles west of Montreal. The branch to Sault Ste. Marie leaves the main line here. Two short railway lines connect the town with its celebrated mines of nickel and copper. The ores are partly reduced in furnaces near the town. Pop. in 1901, 2027.

**SUDDEN DEATH** is usually considered to be that which occurs without immediate previous warning. Any severe shock to the system, as a concussion or strong mental emotion sufficient to depress the powers of the circulation, produces sudden death; and this mode of dying is called syncope. A common faint is an illustration of this principle, and if not speedily recovered from, this state ends in death. (See **SYNCOPE**.) If access of air to the lungs is hindered, as in suffocation, the arterialization of the blood is prevented, and death by asphyxia ensues. A common cause of sudden death is that dependent upon valve disease of the heart. In certain forms of valve disease minute particles of fibrin are deposited from the blood on the edges of the valve. One of these, detached from the valve and caught in the blood current, may cause death by being carried to the brain and blocking some vessel there. In many instances, after a concussion, &c., the person affected is in danger of dying from syncope, but recovers from it and passes into a state of coma. This often happens in a fit of apoplexy, which depends on pressure on the brain. (See **APOPLEXY**.) A sudden and severe blow upon the stomach, sometimes a drink of cold water when the body is heated or exhausted, may induce fatal syncope. The effects of intense heat, whether applied to a portion of the body, as in the case of a severe burn, or to the whole of it, often act as a concussion, and bring on fatal syncope. Lightning, when fatal, produces the fatal result by shock to the nervous system. Intense cold may act on the body in the manner of a concussion, and bring on fatal syncope. Various gases, such as carbonic acid gas, excite such violent spasms that the top of the larynx is closed, and, no air entering the lungs, death by asphyxia comes on.

**SUDETENGEIRGE**, a mountain-chain of Europe, which, taken in its most general sense, includes all the mountain ranges which extend along the southern frontiers of Prussia and Saxony from the source of the Oder to that of the Elster; in a narrower sense the chain which stretches east to west between Prussian Silesia and Moravia, and terminates at the source of the Neisse. Its culminating point is the Spiegeltzer-Schneeberg; height about 5000 feet. The mountains are chiefly composed of granite, which covers a large extent of surface, but often lies concealed under gneiss and primitive schists. The prin-

alpine streams which rise in it are the Neisse on the north and the March or Morawa on the south. It contains mines of copper, lead, zinc, and iron, and coal is found on some of its northern slopes. Tin, cobalt, silver, and gold are also found in small quantities. The lower regions exhibit fruitful fields and fine meadows; higher up the mountains are well wooded, the trees belonging almost entirely to the conifers; the summits of the ridges are bare, or covered with a kind of dwarf fir.

SÜDRAS. See SOODRAS.

SUE, MARIE-JOSEPH-EUGÈNE, a celebrated French novelist, was born at Paris on 10th December, 1804. His father, grandfather, and great-grandfather were all eminent physicians and surgeons. His Christian name of Eugène was derived from Eugène Beauharnais, who, with his mother the Empress Josephine, officiated as sponsors for little Sue at the baptismal font. Having adopted the hereditary profession of medicine, he was, through his father's interest at court, appointed, when not yet twenty-one, aide-major to a company of the royal body-guards, and shortly afterwards, in 1828, accompanied the Duc d'Angoulême on his Spanish expedition as a member of his staff. In 1825 he exchanged the military for the naval service, and in the capacity of surgeon visited Asia, America, the West Indies, and the Mediterranean, in which last he was present at the battle of Navarino in 1827. Not long after this his father died, leaving him an immense fortune, and Sue abandoned the sea and the medical profession for the brilliant and joyous life of Paris. For several years he revelled in all the enjoyments of the French metropolis, dazzling the *beau monde* with the splendour of his feasts and equipages, and in his more serious moments devoting himself to painting and literary composition. His career as an author was inaugurated about 1830 by the publication of *Kernock le Pirate*, in which he was the first to introduce to the French public the sea novel. The effort was successful, and a series of romances, chiefly relating to the sea, were issued from his pen in rapid succession. These were *Plick et Plock*, *Atar-Gull*, *La Salamandre*, and *La Vigie de Koatven*. The spirit in which most of them is written is far from a wholesome one, scenes of horror and revolting sensuality being alternately mingled, whilst human nature is regarded in its most fearful and depraved aspects, and the existence of virtue and goodness almost entirely ignored. Stimulated by success, and also to repair the paternal fortune, which had sadly dwindled down through a course of lavish expenditure, our author wielded his pen with untiring industry, entering the departments both of historical fiction and the novel of real life. Of the former description were *Latreaumont*, *Jean Cavalier*, *Létorières*, and *Le Commandeur*; of the latter were *Arthur*, *La Concaratcha*, *Deleytar*, *L'Hôtel Lambert*, and *Mathilde*. But his fame was now to extend beyond France. The celebrated *Mystères de Paris*, which created so immense a sensation, was contributed by him to the columns of the *Journal des Débats*, and produced him upwards of £4000. A no less success was achieved by his *Juif Errant*, which appeared in the *Constitutionnel* newspaper, and riveted every one by the fascinating interest of its story. The attacks, however, on the Roman Catholic Church and the Jesuits, an exposure of whose malpractices is the leading aim of the work, brought the thunders ecclesiastic on the author's head, and a public excommunication of him was pronounced by one of the French bishops. His later novels are *l'Enfant Trouvé*, *Les Sept Péchés Capitaux*, *Les Mystères du Peuple*, and several others, but none of them come up to the standard of *Les Mystères de Paris*

and *Le Juif Errant*. He also published in 1835 the first part of a *Histoire de la Marine Française*, which, however, never was completed, and partakes more of the nature of romance than real history. Many successful dramatic pieces were likewise produced by him, chiefly melodramas. The Socialist views shadowed forth by Sue in the *Mystères de Paris* and the *Wandering Jew* were unqualifiedly professed by him after the revolution of February, 1848, when he joined the extreme democratic party, and in 1850 was elected a member of the National Assembly. The *coup d'état* of December, 1851, placed him at the head of the list of the proscribed; and compelled thus to exile, he selected Annecy in Savoy as his place of abode. Through the Belgian press he continued to give to the world his socialistic theories in the *Mystères of the People* and other publications. But his health was now declining, and on 3d August, 1857, having been attacked by a severe fit of neuralgia, followed by hemiplegia and paralysis of the left side, he expired at Annecy after a week's illness.

SUEABORG. See SWEABORG.

SUECA, a town, Spain, on the left bank of the Júcar, 23 miles south of Valencia, with broad streets and well-built houses, a parish church, court-house, and several schools. While in the possession of the Moors it was a flourishing place, but decayed greatly after their expulsion. Its prosperity has recently revived, and there are now several flour and rice mills, and manufactures of bricks and tiles. Pop. (1887), 13,613.

SUET, the fatty tissue situated about the loins and kidneys of certain domestic animals, especially the ox and sheep, and which is harder and less fusible than the fat from other parts of the same animals. Beef-suet is much used for culinary purposes, and purified mutton-suet forms an ingredient in ointments, cerates, and plasters.

SUETONIUS (full name, CAIUS SUETONIUS TRANQUILLUS), a Roman writer, the son of a military tribune, flourished about 100 A.D. Little is known of the circumstances of his life. He distinguished himself as an advocate, obtained the tribuneship through the influence of Pliny the younger, and was appointed secretary (*magister epistolarum*) to the Emperor Hadrian. From an expression of Spartian in his *Life of Hadrian* we learn that Suetonius lost this place on account of his intimacy with the Empress Sabina; but the particulars of the affair are unknown to us. His chief extant works are *Vitæ Duodecim Cæsarum*, and the treatises *De Illustribus Grammaticis* and *De Claris Rhetoribus*, both of which are supposed to be parts of a larger work. The former work gives an interesting account of the private life and personal character of the twelve first Roman emperors from Julius Cæsar to Domitian, and is of great value to us from the light which it throws on domestic manners and customs. Among the best editions of Suetonius are those of Wolf (1802), Baumgarten-Crusius (1816-18), and Roth (1858). There is an English translation by Thomson and Forester in Bohn's Classical Library.

SUEUR, LE. See LESUEUR.

SUEVI, the general name of a number of united tribes who, before the Christian era, inhabited the greater part of Germany. The Hermunduri, Semnones, Lombards, Angles, Vandals, Burgundians, Rugii, and Heruli, were the most important, at least the best known. In Cæsar's time they advanced to the Neckar and the Rhine. Tacitus says that their name was derived from the queue in which they tied their hair. In the great migration of the northern nations the Suevi joined the Alans, entered Gaul, and in 409 Soain. After the Vandals had gone to

Africa the Suevi spread as far as Portugal. The Visigoths overcame them entirely in 586, and their empire and name disappeared from Spanish history. Those of them who remained in Germany were the ancestors of the present Suabians.

SUEZ, a town of Egypt, on the borders of Arabia, situated at the north end of the Red Sea, and at the south end of the Suez Canal, 76 miles east of Cairo, with which and with Alexandria and other towns it is connected by rail. Until recently it was a small, ill-built, miserable-looking place, badly supplied with fresh water; but the construction of the Suez Canal, and of the fresh-water canal from the Nile (see next article) has caused a great change. The fresh-water canal has been taken advantage of for irrigation, which has quite altered the appearance of the land around. In the town the houses, offices, and warehouses of European merchants are now to be seen in every direction. Among the principal buildings are the Greek church, viceroy's villa, two hospitals, custom-house, &c. There is here a salt manufactory established by the Egyptian government. A stone pier carrying a railway, stretches from the town across an extension of the Red Sea (dry at low water) to Port Ibrahim, at the mouth of the Suez Canal. The population before the construction of the canal was 1500; it is now 15,000.

SUEZ CANAL. This great canal, which may be said to have converted Africa into an island, runs for nearly 100 miles, from Port Said on the Mediterranean to Suez on the Red Sea, forming a channel navigable for large vessels between the two. It is not the first work of the kind constructed in the same locality—a large canal from the Red Sea to the Nile being known to have existed from six centuries before the Christian era to the latter part of the eighth century after it, when it finally became choked up and useless. Napoleon I., when in Egypt, had thoughts of making a great ship canal across the isthmus; and from that time various schemes for accomplishing this were proposed. At last, about 1854, M. Ferdinand de Lesseps, a French engineer, obtained from the late Saïd Pasha, viceroy of Egypt, the concession or exclusive privilege of making a ship canal from Suez to Tineh on the Mediterranean; and after his plans had been weighed and debated for years he was able to form a company in 1858 for the purpose of carrying them out. Half the shares were taken in France, one-fourth in Egypt, and very few in England, mainly owing to Lord Palmerston's objections on political grounds and Robert Stephenson's on engineering considerations. After many compromises the following important conditions were agreed to:—The land on both sides of the canal is to be retained by the company for ninety-nine years. The quantity of this land is only to be sufficient for the purposes of the canal and for the various works at Port Said, Ismailia, and Suez; none of it is to be sold to other parties. All persons residing upon the conceded land are to be subject to the same local and consular jurisdiction as residents in other parts of Egypt. Some of the privileges originally granted to the company by the viceroy of Egypt were bought back by him at very high prices; some others he was unable to fulfil, and paid a corresponding compensation by remitting certain demands which he would have been otherwise entitled to make. In these and in other ways the viceroy became largely interested in the scheme. In November, 1875, the British government bought from the viceroy his interest in the canal, consisting of 176,602 shares, for about £4,000,000, now yielding about £880,000.

The work was begun on the 25th April, 1859, and it was estimated that the canal would be wholly completed in 1864, at a cost of £6,000,000. It

was opened only on the 17th November, 1869, and the total cost was about £16,000,000. Large numbers of men were of course required for the works, and crowds of Fellahs, Arabs, Nubians, Negroes, Sicilians, Greeks, &c., were engaged upon them, while dredges and other machines of great power were also employed. To facilitate the construction of the great canal a service canal 20 feet wide and 5 deep was constructed for part of the distance, by which men and materials could easily be conveyed. A canal was also constructed for bringing fresh water from the Nile at Bulak near Cairo, since without an extensive supply of this necessary of life the canal works could not have been carried on in the waterless region of the isthmus. This canal reaches the salt-water canal at Ismailia, about midway between the Mediterranean and the Red Sea, and then runs almost parallel to the course of the ship-canal till it arrives at Suez. Previously existing canal works were partly available for the fresh-water canal. It has proved a boon to the country all along its banks. It is about 40 feet wide and 9 deep, and is used for navigation as well as for domestic purposes and irrigation. From Ismailia to Port Said fresh water from this canal is conveyed through large pipes. Plugs are inserted in the pipe along the route where necessary to allow the withdrawal of water for domestic or other purposes. The great canal itself differs in dimensions in different places, being narrowest where the amount of cutting was greatest. For about four-fifths of its length (77 miles) it was at first 327 feet wide at the surface, 72 at the bottom, and 26 deep; for the remainder (22 miles) it was only 196 feet wide at the surface, the other dimensions being the same. Many portions of the canal were easily enough made, but at other points the excavation demanded an immense amount of labour. In one place the workmen had to cut a passage 90 feet deep and 200 wide through sandstone rock. Port Said was chosen as the Mediterranean entrance of the canal instead of Tineh, because here the deep water is nearer the shore. It has grown up since the works commenced, and possesses basins, quays, a lofty lighthouse with electric light, &c., and a harbour protected by two breakwaters or piers, the one 2070 yards long, the other 2780. Leaving Port Said the canal first passes for about 24 miles along the eastern margin of Lake Menzaleh, an extensive and very shallow lagoon. The water of the lake is not admitted into the canal, which is confined between embankments, and is from 26 to 29 feet deep—much deeper than the lake. Beyond Lake Menzaleh occurs a sandy strip of 3 or 4 miles, after which the canal enters Lake Ballah, where embanking and dredging had again to be resorted to; passing through this for about 8 miles it next runs through a land portion of the same length, in which occurs the formidable cutting mentioned above, and it then reaches Lake Timsah, about half-way across the isthmus. This is a small lake, and had long been dry, but is now filled with sea-water, and abounds with fish. Lake Timsah is a stopping place for vessels passing through the canal, and affords a large space suitable for anchoring. Between Port Said and Lake Timsah the canal is nearly straight, and between the former place and Lake Ballah quite so; the southern half of its course is more winding. On the western shore of Lake Timsah is situated the town of Ismailia, which owes its existence entirely to the canal and the railway which connects it with Zagazig, Cairo, and Alexandria. At Ismailia the fresh-water canal is connected with the great canal by means of locks, their levels being different. In the 9 miles through which the great canal is carried after leaving Lake Timsah enormous quantities of rock had to be removed; then come the Bitter Lakes, like Lake

Timsah formerly dried up, but now filled with seawater; then a length of 17 miles, partly through a shallow lake, partly through a sandy desert, after which the canal reaches its terminus at Suez. Extensive works have been constructed here, among which are a mole 850 yards long; a dry dock, 418 feet by 95, built by the Khedive of Egypt; another, 860 feet by 85, for the Peninsular and Oriental Company; &c.

The shipping passing through the canal has steadily increased since its opening. In 1870, 486 vessels, of a total burden of 654,915 tons, sailed through it, yielding the company an income of £206,400; in 1874, 1264 vessels of 1,649,188 tons passed through, and the receipts amounted to £1,029,492. In 1900, 3441 vessels, of 13,699,238 tons gross measurement, passed through, the receipts being about £3,625,000. The passengers passing through numbered 282,203. Fully one-half of the tonnage passing through is British. After Britain, in decreasing order, come the vessels of Germany, France, Holland, Austria, Russia, Japan, and Italy. The tolls charged are 9 francs per ton for laden passenger or cargo steamers and war-ships; 6½ francs per ton for ships in ballast without passengers; and 10 francs for each passenger. These heavy tolls, and the resulting enormous profits, together with the fact that Britain was miserably represented on the board of management, in course of time created much dissatisfaction among British ship-owners, and in 1883 there was much talk about the construction of a second canal. This came to nothing, but led to the widening and deepening of the existing canal, and the construction of large basins to allow north and south going vessels to pass each other. Since Jan. 1, 1902, the maximum draught for vessels has been fixed at 8 mètres (26½ feet). The depth is to be increased to 9½ mètres, and additional stations for large vessels are to be provided. The distance between London and Bombay by the old route round the Cape is about 11,220 miles; by the new route opened up by the canal 6332 miles. Steamships are allowed to sail at a speed of 5 to 6 knots an hour along the canal.

**SUFFOCATION.** See ASPHYXIA, DROWNING, SUDDEN DEATH.

**SUFFOLK,** a maritime county of England, bounded on the east by the German Ocean, on the south by Essex, on the north by Norfolk, and on the west by Cambridgeshire. It extends about 56 miles in length and 32 in breadth, has a coast-line of 50 miles, and an area of 1482 square miles. The county is bounded on the north, south, and west by navigable rivers, and is intersected by numerous streams. The navigable rivers are the Lark, forming part of the western boundary, and joining the Great Ouse near Mildenhall; the Waveney, on the north boundary; the Stour, which forms a wide estuary opening to the sea at Harwich; the Gipping, which runs south-east by Needham-Market to Ipswich, where it takes the name of the Orwell, and, expanding into an estuary, unites with that of the Stour to form the harbour of Harwich. The Deben has its source near Debenham, and, passing Woodbridge, widens into Woodbridge Haven. The Alde, after approaching very near the sea at Aldeburgh, where it expands greatly, turns towards the south and meets the sea below Orford. The county is traversed by the main line and branches of the Great Eastern Railway. Suffolk generally presents a level surface, the eminences being inconsiderable. The soil varies much in different parts, and the kinds of land may be distributed into clay, sand, loam, and fen. In the interior is a tract extending from north to south, consisting chiefly of a strong clay, fertile in a great degree for all the objects of hus-

bandry. Here is made much butter for the London markets. The sandy districts occupy the eastern and western borders of the county, that towards the coast being highly cultivated. Great changes have taken place on the Suffolk coasts in consequence of the encroachments of the sea. On the opposite side of the county the sands are spread over nearly the whole of the north-west angle, in which are a few spots of rich land, but the district chiefly consists of barren heaths and sheep-walks; and towards the Norfolk border the sand is light and subject to be driven by the wind, as is also the case with the south-eastern sandlands between Woodbridge, Orford, and Saxmundham. In these sandy districts are many extensive rabbit warrens. The loam districts are found almost exclusively on the borders of the rivers. Wheat, barley, pease, beans, and mangold-wurzel are grown to perfection. Of a total area of 948,765 acres more than four-fifths is under crops, rotation grasses, or permanent pasture, whilst about 30,000 acres are mountain and heath land used for grazing, and some 34,000 are under woods and plantations. The Suffolk cart-horse is well known for its power of draught, its chestnut colour, and its short legs. A black pig of small size is also largely bred and much esteemed. The trade of the seaports depends greatly on the exportation of corn and malt; fine sea-salt is made on the coast; the herring and mackerel fisheries are carried on at Lowestoft and several other places, whilst Aldeburgh is noted for its sprats, and oyster-beds are found in the Orwell and the Orford rivers. The municipal boroughs of the county are Ipswich, Lowestoft, Bury-St.-Edmunds, Beccles, Sudbury, Aldeburgh, Eye, and Southwold. Since the passing of the Redistribution Act of 1885 it has but two parliamentary boroughs, Ipswich (the county town) and Bury-St.-Edmunds, the former returning two and the latter one member to Parliament. There are five parliamentary divisions, namely, Eye, Lowestoft, Stowmarket, Sudbury, and Woodbridge. Pop. in 1891, 371,235; in 1901, 384,198.

**SUFFRAGANS.** See BISHOPS.

**SUFISM,** a system of Mohammedan mysticism, which strives for the highest illumination of the mind, the most perfect calmness of the soul, and the union of it with God by an ascetic life and the subjugation of the appetites. This theosophy, clothed in a mystico-religious garb, has been professed since the ninth and tenth centuries by a sect which at present is gaining adherents continually among the more cultivated Mohammedans, particularly in Persia and India. The Arabians had from the earliest times an inclination to a life of religious contemplation and monastic solitude. Hence even under the first caliphs ascetic religious fraternities were formed. As the four orthodox Mohammedan sects established several systems of scholastic philosophy, and a number of monkish orders grew up in the second century of the Hejra, devout persons, perplexed by this labyrinth of discordant theological opinions, found consolation in pious mysticism. This was the origin of the Sufis, whose idea of a mystical union of man with God gave rise to fanaticism similar to that of the Christian mystics. The Sufis teach their doctrines under the images of love, wine, intoxication, fire, &c.; and the songs of Hafiz, one of the most distinguished Sufis, which seem to be Anacreontic strains in praise of love and wine, should rather be considered as setting forth the mystic doctrines of his sect. At first the teachings of the Sufis tended to the promotion of religious feeling even in the view of orthodox Mohammedans, but gradually they led to a mode of thought totally irreconcilable with the dogmas of Mohammedanism. Many of the precepts of the Koran, instead of being

literally followed, received from the Sufis an allegorical interpretation, and some of the doctrines of the Koran were explained in the same way. About the end of the ninth or the beginning of the tenth century the Sufis divided into two branches, one of which embraced pantheism, while the other sought to reconcile Sufism with Mohammedanism. The doctrines of the pantheistic section of the Sufis agree so remarkably with those of the Indian Vedānta that it can hardly be doubted that they had an Indian origin. Several of the most eminent of the Persian poets belonged to the Sufis. In this number are included, besides Hafiz, already mentioned, Senāyi, who in his *Hadika* (Garden), written about 1160 A.D., gives expression to Sufi philosophy; Ferid-ed-din Attar, a contemporary of Senāyi, and author of two great poems, *Mentek Ettair* (Conversation of the Birds) and *Javāhir Essāt* (Attributes of Being), in which he shows forth the various degrees of intuition to which the Sufi can attain, as well as of a collection of biographies of the most distinguished Sufis, under the title *Teskeret el-evliya* (Portraits of Friends); Jelāl-ed-din-Rūmi, who flourished about two generations later than the first two, and wrote the great poem *Mesnevi* (that is, doubled-rhymed poem); and Jami, who lived in the fifteenth century. (See JAMI.) The celebrated philosopher and jurist Alghazzālī was also an adherent of this sect. See Palmer's *Oriental Mysticism* (1867).

**SUGAR.** The name sugar is applied to various compounds of carbon, hydrogen, and oxygen, all of which have a more or less sweet taste, a neutral reaction to vegetable colours, and are soluble in water. The sugars are generally of vegetable origin; and among them the sugar which is so familiar as an article of consumption, and which is obtained from the sugar-cane and from beets, is distinguished *par excellence* by the name sugar. We propose to notice (1) briefly, the history of sugar; (2) the manufacture of sugar from the cane and from beets; (3) shortly, the chemical relationships of the various members of the sugar group; some trade figures being added.

The word *sugar* comes from the French *sucré*, and is supposed to be derived from the Persian *sukkur*, which again may probably be traced to the Sanskrit *sarkara*, sugar. According to various authorities sugar has been known in India since a very early period, and the Chinese seem to have derived their knowledge of it from that country. In several passages of the Old Testament we find mention made of 'calamus' and 'sweet calamus', probably a species of sugar-yielding cane. Herodotus speaks of manufactured honey, by which he probably meant what we now call sugar. Theophrastus mentions honey obtained from a reed which grew in moist places in Egypt, and which had a sweet root. In Pliny we read of a kind of honey which is collected from reeds as a white gum-like mass, brittle to the teeth. The Crusaders found sweet honeyed canes in the meadows near Tripoli, in Syria, which were called *zuora*. The juice of these reeds, says Albertus Agnensis, was obtained by bruising the plants, after which it was strained and set aside in vessels until it hardened to a snow-like mass, which was then mixed with bread or water and eaten. Sugar seems to have been imported into Venice as early as 990. In the twelfth century it was imported into Northern Europe, generally from Sicily and Egypt, but only in small quantities. The Moors of Spain obtained the cane from Egypt, and the Spaniards from the Moors. By the Spaniards it was introduced in the fifteenth century into the Canary Islands, and by the Portuguese into Madeira, whence it was carried to the Brazils and the West India

Islands. Hawkins appears to have first brought sugar to England from the West Indies about the year 1560; but it was not until the early part of the nineteenth century that sugar began to come into really general use in Great Britain.

Sugar, in the ordinary sense, is prepared from the sugar-cane and from beets. The sugar-cane (*Saccharum officinarum*) is a plant of the grass order; it grows to a height varying from 8 to 20 feet; its stalk is round, knotted, and hollow; the leaves, which attain a length of 5 or 6 feet, are ribbed. The beet from which sugar is principally obtained is the white variety (*Beta alba*) of the species *Beta vulgaris*, or common beet, the mother plant of all the white varieties now grown in Germany, Austria, France, Russia, Belgium, Holland, &c., and for some years also grown in the United States of America, and more recently introduced into Australia. The first experiments relating to the existence of sugar in the beet-root seem to be those of Marggraf in 1747. An impetus was given to the cultivation of beet in the time of the first Napoleon, who excluded cane-sugar from the French markets; but it was not until some time after his death that the trade in beet-sugar attained to large dimensions. (See the article BEET.) The countries which produce the largest quantities of beet-sugar are Germany, Russia, Austria, France, Belgium, and Holland. Germany produces absolutely the largest quantity, France coming next, while Belgium produces the largest quantity per acre.

The following table shows the average composition of the sugar-cane and beet respectively:—

	Sugar-cane.		Beet.
Sugar.....	18.00	....	18.32
Water.....	72.00	....	82.68
Cellulose.....	9.50	....	1.00
Albumen, &c.....	—	....	1.50
Salts.....	0.50	....	1.55

The first operation in the manufacture of sugar consists in pressing the juice from the cane or from the beet. The canes are made to pass between large iron rollers, and the expressed juice is collected in reservoirs: about 90 per cent of the juice is usually extracted. In the crushing of beets a machine is used in which the beets are squeezed against rotating cylinders furnished with saw-edges; the pulp thus obtained is pressed between rollers or in a Bramah press, or the juice is sometimes expressed by means of a centrifugal machine. The expressed cane-juice is run into the clarifier, which has a coil of steam-pipe at the bottom, and sulphurous acid (for bleaching and cleansing) is added and heated to a temperature of 176° F., milk of lime being then added to neutralize acidity in the juice and coagulate albuminous compounds. The temperature is maintained until a scum rises to the top and appears about to crack, when the steam is shut off, and the liquor allowed to settle for an hour. It will be found, if the juice has been properly 'tempered', that the scum remains at the top while the heavier insoluble matters will have settled to the bottom, leaving a fine pale straw-coloured juice between, which is run off by means of cocks placed at different heights in the clarifier. The scum and insoluble matters are removed to a filter-press and the remaining juice extracted.

Having obtained a juice of sufficient purity it now remains to concentrate until crystallization is effected. This may be done either in a single vacuum-pan, or in 'double', 'triple', or 'quadruple' 'effects', but space will not permit to describe each in detail. The process carried out in large sugar-mills is with the 'triple' or 'quadruple' effect, and for illustration we might take a triple-effect appa-

ratus. It consists of three vacuum-pans connected with each other. The clarified cane-juice is run into the first pan, in which a vacuum of about 8 inches of mercury is maintained, and heated directly by steam of 5 lbs. pressure per square inch (227° F.). The vapour from the juice in the first vessel is utilized for heating the still more concentrated juice in the second one, in which a vacuum of 14 or 15 inches is maintained, and in like manner the vapour from the juice in the second vessel is utilized to evaporate the juice in the third vessel, which should have a vacuum of about 28 inches or thereby. Thus, by taking advantage of the latent heat of the vapour from the juice in the first and second pan a great saving in fuel is effected. Theoretically 1 lb. of steam used in a 'triple' effect will evaporate three times as much water from the juice as 1 lb. of steam used in a single vacuum-pan, in addition to the low temperature, corresponding to the vacuum obtained in the different vessels, preventing darkening of the juice by overheating. Crystallization takes place in the third vessel, and when the desired size of crystal is produced the contents are run off and the crystallized sugar separated from the remaining liquor by running the 'massecuite', as it is termed, into centrifugals. A second sugar is made from the separated liquor, and the liquor from it again turned out as third sugar and molasses. The raw sugar has now to be refined, much of it being sent to Britain for this operation. In order to prepare raw beet-sugar, the expressed juice is heated to about 70° C. by steam; milk of lime is added, and the temperature is increased; the lime separates impurities in the form of phosphate of calcium, albuminate of calcium, &c., which cover the surface with a dense white crust. As soon as the boiling juice begins to break through the crust the liquid is run off; the residue is pressed, and the syrup thus obtained is added to the decanted liquid. Carbonic acid is now passed through this liquid, whereby the greater part of the lime is removed as insoluble calcium carbonate. The syrup is now filtered through animal charcoal, concentrated by heating in the vacuum-pan, again filtered, and allowed to crystallize.

As already stated, the raw sugar requires to be refined. For this purpose it is dissolved in water in an apparatus called a 'blowup', stirring-gear being fitted so that solution of the sugar is rapidly accomplished. The solution is heated to 170° F. and brought to a density of 28° Baumé, lime being added to neutralize any acidity. The liquor is now led to Taylor filters, which remove mineral and suspended organic matters. The Taylor filter consists of a chamber made of cast-iron plates open at the top, forming a receiving tank or filter-head. The bottom plate is perforated with holes in rows a short distance apart, these being fitted with gun-metal sockets into which are screwed gun-metal bells, to the open mouths of which the filter-bags, made of

twilled cotton, are tied, woven hempen sheaths open at both ends being placed over the bags. The sheath serves to restrict the expansion of the bag, and at the same time gives a large filtering surface in a small space. The front of the chamber in which the bags hang down is furnished with close-fitting doors, by which access to the chamber is got. When the filters are to be used the doors are closed, and steam blown through so that the chamber may have a temperature equal to the liquor passing through. The liquor as it comes from the filters is sampled frequently so as to ensure clearness. It is next run over animal charcoal contained in cisterns from 15 to 20 feet in height and 8 or 10 feet in diameter. At a short distance from the bottom of each cistern a perforated wood or iron false bottom is placed. Cloth is spread over this, and then the cistern is filled with char and ready for use. The liquor as it comes from the char should be bright and almost colourless.

In order to induce crystallization the liquor must be boiled down, but the temperature required (110° C. or 230° F.) is under ordinary circumstances so high as to bring about the transformation of part of the crystallizable into uncrystallizable sugar. To prevent this action and at the same time concentrate the liquor, vacuum-pans are made use of. The vacuum-pan consists essentially of two air-tight hemispherical vessels, firmly joined together, connected with an air-pump, a condenser, and a pipe for admitting steam. The liquor being admitted into the pan, the air-pump is set in motion, and a partial vacuum is produced in the interior. Steam is now caused to circulate through a pipe which is coiled within the pan until the liquid boils, while the vapour hereby produced is removed and condensed. The syrup is thus boiled down without attaining a higher temperature than about 70° C. The point to which concentration is carried is decided by an experienced workman, who, by the use of a 'proof-stick', is able to extract a quantity from the pan (without destroying the vacuum) and ascertain its exact state. When concentrated, a slight addition of fresh liquor is run in, which disturbs equilibrium and causes some of the sugar to crystallize out of the supersaturated solution. More liquor in successive charges is run in and the crystals gradually grow in size. When the pan is full a large portion of the contents is run off into heaters, where it is kept constantly in motion with stirring-gear until it can be run into the centrifugals and the sugar and syrup separated. The sugar in the centrifugal is washed with a little water or steam while the machine is in motion, so that the desired colour and appearance of the sugar wanted is arrived at. The portion of sugar and liquor left in the pan is fed with fresh liquor, and in this way larger crystals are produced. The sugar as it comes from the centrifugals is spread on floors to dry, and is then ready to be bagged and placed on the market for sale.

100 kilos. of beets yield on an average 1st product containing 97 per cent pure sugar .....	5.8 kilos.
" " " 2nd " " " 92 " " " .....	2.25 "
" " " 3rd " " " 87 " " " .....	0.80 "
	8.85 kilos.
" " " 4th " molasses, &c.....	8.65 "
Total.....	12.50 kilos.

The *molasses* already mentioned is the dark-coloured impure liquid separated from the sugar proper in the process of refining. It consists of a mixture of crystallizable and uncrystallizable sugar and organic matters coloured by caramel: *syrup*, or *golden syrup*, is a finer kind of molasses. Large quantities of the molasses obtained in making cane-

sugar are used in the manufacture of rum, especially in the West Indies.

*Sugar-candy* is prepared by boiling sugar syrup with a little animal charcoal, clearing with white of egg, filtering, boiling down over an open fire, and crystallizing. The crystallization takes place in a vessel whose sides are perforated. The small crystals

which form are removed, together with the adhering syrup, by means of warm dilute lime-water. Sugar-candy is known in commerce as *refined white*, which forms large colourless crystals, and is prepared from refined cane-sugar; *yellow candy*, forming straw-coloured crystals, prepared from boiled sugar; and *brown candy*, similar in colour to ordinary moist sugar, and prepared from inferior cane-sugar. Sugar-candy is largely used for making liqueurs, for sweetening champagne, &c., and as a vehicle for administration of nauseous medicines; the inferior kinds are often used in restaurants for sweetening coffee and tea.

A form of sugar different from that of the cane or beet is manufactured in tolerably large quantities, chiefly for the use of the brewer and wine-maker; it is called *grape-sugar*, and has the formula  $C_6H_{12}O_6$ ; it is also known by the names of *honey-sugar*, *fruit-sugar*, *starch-sugar*, &c. Grape-sugar occurs in many natural fruits, such as the peach, plum, raspberry, strawberry, currant, gooseberry, pear, apple, and grape, in quantities varying from 1.5 per cent in the peach to 15 per cent in the grape. It also forms the solid crystalline portion of honey. Grape-sugar is not so easily crystallized as cane-sugar, and is possessed of much less sweetening power than that variety. Grape-sugar may be prepared from grape-juice by heating it with marble, allowing it to stand so long as solid matter separates out, filtering, clearing with ox-blood, evaporating, and crystallizing. It is, however, more generally prepared by boiling starch with dilute sulphuric acid, in the proportion of 2 kilos. of ordinary sulphuric acid, diluted with 300 or 400 litres of water, to 100 kilos. of starch. The excess of acid is removed by the addition of carbonate of calcium; the clear liquid is run off from the precipitated sulphate of calcium, evaporated down by steam, filtered through animal charcoal, and run into the crystallizing vessels. These vessels are fitted with perforated bottoms, which may be opened or closed at pleasure; through these the molasses is run off after the sugar has crystallized. Grape-sugar is used in brewing, being added to the malt before distillation; it is also employed instead of honey in confectionery, and for colouring cognac, wines, &c.

With regard to other sugars of some importance as articles of food we may specially mention *maple-sugar*, *palm-sugar*, *sorghum-sugar*, and *maize sugar*. Maple-sugar is made to some extent in the United States and Canada, being obtained from the sap of the sugar-maple. The trees are tapped in spring by boring holes from which the sap flows. Palm-sugar is obtained similarly from incisions made in the date-tree and some other species of palm. Sorghum, like the sugar-cane, is one of the grasses. Some sugar is made from it in the United States and elsewhere, the process being similar to that adopted in the case of cane-sugar.

It remains to notice briefly the chemical constitution and relationships of the sugars. The sugars are, for the most part, carbohydrates; they contain carbon, hydrogen, and oxygen, the latter elements in the proportion to form water. They may be classified thus:—

#### CLASS I.—FERMENTABLE SUGARS.

(a) *Glucoses*,  $C_6H_{12}O_6$ .

Dextrose or grape-sugar.

Levulose.

Galactose.

&c.

(b) *Saccharoses*,  $C_{12}H_{22}O_{11}$ .

Cane-sugar.

Lactose or milk-sugar.

Maltose.

&c.

#### CLASS II.—NON-FERMENTABLE SUGARS.

Sorbitol..... $C_6H_{12}O_6$ .

Mositol..... $C_6H_{12}O_6$ .

Mannitol..... $C_6H_{12}O_6$ .

Quercitol..... $C_6H_{12}O_6$ .

&c. &c.

The glucoses, and also the saccharoses, are distinguished from one another by their physical properties, chiefly by their action on a beam of polarized light (see POLARIZED LIGHT), the plane of which is rotated by some to the right, by others to the left; the amount of rotation being also different for the different bodies.

Grape-sugar or dextrose ( $C_6H_{12}O_6$ ) is very probably the aldehyde of a hexatomic alcohol ( $C_6H_5(OH)_6$ ), while cane-sugar ( $C_{12}H_{22}O_{11}$ ) appears to be formed by the combination of two molecules of this aldehyde with simultaneous elimination of water, thus:  $2 C_6H_{12}O_6 = C_{12}H_{22}O_{11} + H_2O$ .

Cane-sugar crystallizes in large monoclinic prisms, which have a specific gravity of 1.606; when broken they exhibit phosphorescence. When heated to 160° cane-sugar melts to a clear liquid, which solidifies, on cooling, to an amorphous mass, to which the name of *barley-sugar* is commonly given. When cane-sugar is boiled with water and a few drops of acid it is converted into a mixture of dextrose and levulose. When an aqueous solution of cane-sugar is mixed with yeast and exposed to a warm atmosphere it is converted into carbon dioxide and alcohol, thus,  $C_{12}H_{22}O_{11} + H_2O = 4 C_2H_5O + 4 CO_2$ .

The quantity of cane-sugar in a solution which contains no other substance may be estimated by simply determining the specific gravity of the solution; if, however, other bodies are present, another process must be adopted.

(1.) The sugar may be estimated by allowing it to ferment in contact with yeast, and estimating either the carbon dioxide or the alcohol produced. One hundred parts of cane-sugar yield, according to Pasteur's experiments, 49.12 parts by weight of carbon dioxide and 51.01 parts of absolute alcohol.

(2.) Another method is based upon the fact that grape or inverted sugar reduces an alkaline solution of copper sulphate with the precipitation of red cuprous oxide. The cane-sugar solution is boiled with a small quantity of acid until it is entirely changed into inverted sugar; the liquid is run from a measuring vessel into a known quantity of a boiling solution, prepared by adding Rochelle salts (acid tartrate of potassium) and caustic potash to copper sulphate, until the whole of the copper is thrown down as cuprous oxide, and the supernatant liquid, which was at first deep blue, becomes colourless. By titrating the copper solution against a liquid which contains a known quantity of sugar, the sugar-equivalent of the quantity employed is easily determined.

(3.) By means of the saccharimeter (or saccharometer), which is an instrument for determining the rotatory power exercised by a solution of sugar upon a ray of polarized light (which see).

The raw cane-sugar of commerce is distinguished by names derived from the country or district from which it is imported. The principal varieties in the English market are West Indian (including Cuban, Jamaica, Porto-Rico, Demerara, &c.), Mauritius, Java, Manila, Brazil, Peruvian, Madras, &c. The total quantity of unrefined sugar imported into the United Kingdom in 1901 was 669,357 tons, which mostly went to Liverpool, London, Greenock, and Bristol. The total quantity of refined sugar imported was 1,062,842 tons, which was landed at the various importing centres. Of the unrefined sugar 220,113 tons came from Germany, 190,546 tons from France, 86,415 tons from Belgium, while Holland,

Java, the Argentine Republic, Brazil, and other foreign countries also contributed to the general total. From the British possessions there came 77,231 tons, chiefly from the West Indies, Guiana, and Mauritius. Of the refined sugar Germany was the largest contributor with 662,022 tons, and next to it France with 247,632 tons, Holland with 130,419 tons, the balance being mainly made up from Belgium. The total quantity of unrefined beet-sugar was 500,472 tons, and cane-sugar 168,885 tons. The total value of the unrefined sugar imported was £6,378,024, of the refined £12,948,656. The export of sugar refined in the United Kingdom was 27,815 tons, which was shipped largely to the British East Indies, Canada, Norway, Sweden, and Denmark.

**SUGAR-CANE** (*Saccharum officinarum*), a plant of the natural order Gramineæ, or Grasses, from the juice of which a large proportion of the sugar of commerce is obtained. It grows on an average to the height of 7 or 8 feet, and its broad leaves and large silky panicles give it a beautiful aspect. The stems are very smooth, shining, and filled with a spongy tissue containing the juice; the flowers are small and very abundant, clothed externally with numerous silky hairs. There are doubts whether the plant grows wild anywhere. The cultivated varieties (or species) are numerous, and vary considerably in size and otherwise. Some are known as red, yellow, black, purple, purple-violet, green, purple-striped, &c.; and the largest kinds, such as the 'elephant cane' of Cochin-China, are said to reach a height of 30 feet. In the West Indies and elsewhere it is propagated by cuttings from the root end. The cuttings root at the joints underground, and from those above send up shoots, which, in eight, twelve, or fourteen months, are from 6 to 10 feet long, and fit to cut down for the mill. A plantation lasts from six to ten years. The juice of the sugar-cane is so palatable and nutritive that during the sugar harvest every creature which partakes freely of it, whether man or animal, appears to derive health and vigour from its use. The sugar-cane is now cultivated in all the warm parts of the globe, such as the West India Islands, Guiana, Mauritius, Brazil, Java, &c. As in the case of other cultivated plants, different kinds are suited for different soils, different manures, &c. See preceding article.

**SUGAR OF LEAD**, the common name for acetate of lead. See **LEAD**.

**SUHL**, a town in the Prussian province of Saxony, in a valley on the Lauter, 30 miles south-west of Erfurt. It was once the most famous place in Germany for the manufacture of arms and articles of knightly equipment, and is still a seat of the manufacture of firearms, especially sporting guns and fancy weapons. There are also manufactures of porcelain, glass, leather, iron-founding, tanning, &c. Pop. (1885), 10,605; (1895), 11,887.

**SUICIDE**. See **HOMICIDE**.

**SUIDAS**, a Greek lexicographer, who must have lived about the tenth or eleventh century. He wrote a Lexicon which forms a kind of cyclopædia and dictionary, giving explanations of words, and notices of persons, places, &c., in alphabetical order, and which, though not perfectly accurate, is yet important, as it contains many things not to be found elsewhere. The best editions are those of Gaisford, Bernhardt, and Bekker.

**SUIR**, a river in Ireland, rises in the Slieve-Bloom Mountains, in the north of Tipperary; flows first circuitously south through that county, passing Cahir; then, after a sudden turn north, flows east, forming the boundary between Tipperary and Waterford; then circuitously *E.S.E.*, forming the boundary

between Waterford and Kilkenny, and passing the towns of Clonmel and Carrick; and after a course of about 80 miles unites with the Barrow to form the fine estuary of Waterford harbour. It is navigable by vessels of 500 tons to Waterford, and by large barges to Clonmel.

**SULIMAN MOUNTAINS**, a range of mountains now practically all in British India, near the Afghanistan frontier. The range consists of several parallel ridges, of which the most westerly form the water-parting between the rivers flowing east to the Indus and those flowing westwards through Afghanistan. It extends north and south from the Safed Koh to about the Bolan Pass, and is crossed by many passes, of which the chief are those of Kuram, Gumal, and Sangar. The highest peak, Takht-i-Suliman, or 'Suliman's Seat', has two summits, 11,295 and 11,070 feet high respectively. These mountains are generally rocky and precipitous, and their sides are completely bare of trees. The passes through them are generally held by independent tribes in alliance with the British.

**SULINA**, the middle one of the three branches by which the Danube discharges its waters into the Black Sea in Moldavia. It quits the St. George's or most southerly branch 2 or 3 miles below Tulcha, and before reaching the sea has an easterly course of above 50 miles. It is the most-frequented branch, and is used for transporting immense quantities of corn, chiefly for the British market. From the neglect into which it fell under Russian sway the bar at the mouth was allowed to accumulate to such an extent as to render the river very difficult of access, but there is now an average depth of 24 feet. In 1894 the European Commission of the Danube began a series of extensive improvements in this arm of the delta. These are still in progress, and when completed the river up to Tulcha will be virtually a straight canal. A small town and port on the right bank near the mouth bears the same name. It is a dreary, unhealthy place both in summer and winter. It has two lighthouses, several churches, and carries on a considerable trade, being a free port. Pop. 5000.

**SULIOTS**, a mixed people of Arnaout and Greek descent, who, to escape the tyranny of the Turks in the seventeenth century, settled in the mountains near Parga, in the south of what is now Albania, occupying a wild valley inclosed on three sides by almost inaccessible mountains, and accessible on the fourth only by a narrow defile. Here their numbers had increased towards the end of the eighteenth century to 10,000 souls, their chief village being called Suli. Their government was republican. Old customs were followed instead of written laws. They were distinguished for the simplicity of their manners and for their bravery. Their mother-tongue was the Albanian, but they also spoke Greek. They lived partly by the rearing of cattle and the chase, and partly by plunder. When, after a struggle of several years, Ali, pasha of Yanina, had rather reduced them to despair than conquered them (1803), most of them abandoned their country. But when Ali found himself hard pressed by the Turks and deserted by the Albanians, he recalled the Suliots to his assistance. When the Greek war of Independence broke out, the Suliots joined the Greeks. Suli was besieged by the Turks, and in September, 1822, was compelled by famine to surrender. Three thousand Suliots then embarked in British ships for Cephalonia; the rest dispersed themselves in the mountains. The corps of 500 men, raised and equipped by Lord Byron at his own expense, was composed of Suliots, for whom he had a great admiration. See **BOZZARIS**.

**SULLA, LUCIUS CORNELIUS**, surnamed **FELIX**, Roman dictator, was born in 138 B.C. The family to which he belonged was originally named **Rufinus**, and was only changed to Sulla by the great-grandfather of the dictator. Sulla received a good education, but indulged himself in his youth, as through the whole of his after-life, in excessive dissipation and debauchery. Yet in his first official position, when he served as quaestor under Marius in the Jugurthine war in 107 B.C., he showed great military and diplomatic talents; and it was through his instrumentality that Bocchus was prevailed upon to surrender Jugurtha to the Romans—an event which terminated the Numidian war (106). Sulla next served under Marius in the Cimbrian war (104–102), until, to avoid the jealousy of the latter, he joined the army of the consul Catulus, who practically left the command in the hands of his new officer. Sulla was present at the battle of **Campi Raudii** in 101 B.C., in which the joint armies of Marius and Catulus finally defeated and dispersed the Cimbri. In 93 Sulla was chosen praetor. Having passed the year of his praetorship at Rome he was, at the expiration of his term, appointed to the government of Cilicia. When acting in this office he, in accordance with the instructions he had received from the senate, established Ariobarzanes upon the throne of Cappadocia, after having in a single battle completely subdued Gordius, guardian of a son of Mithridates, then on the throne. He then concluded an alliance with the King of the Parthians, and conducted himself with so much haughtiness that one of the Cappadocians present exclaimed, 'Surely this man is or will be master of the world.' In the Social war (90–88), in which Sulla and Marius were at the head of two separate armies, the indefatigable activity and daring courage of the former threw the reputation of the latter into the shade. The consulship was the reward of his services (B.C. 88); and the province of Asia, with the conduct of the war against Mithridates, fell to his lot. But Marius was also ambitious of this command, and in order to carry his point resorted to acts of violence, by which Sulla was compelled to make his escape from Rome, whereupon Marius procured a decree of the people that the coveted command should be intrusted to him. But Sulla now re-entered Rome at the head of his army, and after setting a price on the head of his enemy finally, at the beginning of 87 B.C., sailed for Greece, a great part of which had been conquered by the generals of Mithridates. Here his good fortune still followed him. He expelled the armies of Mithridates from Europe (86), crossed into Asia (84), where he was still victorious in every direction, but finally granted peace on his own terms to the enemy, on account of the state of affairs in Italy (84). During his three years' absence from Italy his enemies had regained the superiority in Rome. Marius had been recalled; the blood of the friends of Sulla had been shed in torrents; he himself had been proscribed, and his property confiscated. Marius, however, had died in 86 B.C., exhausted by age and tortured by a guilty conscience. But the leaders of his party, Cinna and Carbo, still continued to conduct the public affairs, when Sulla, having intrusted the chief command in Asia to Murena, hastened to Italy at the head of 40,000 men. He landed at Brundisium in 83 B.C., and was joined by many of his friends who had been banished from Rome. His enemies were much superior in numbers, but his courage and address rendered him victorious. After having gained four battles over the Roman forces in person, besides several through his generals, and at the close of the war defeated a Samnite army under Telesinus before the walls of Rome, and having witnessed the destruction

of his enemies, he entered the city as a master (82). One of his first acts was to put to death between 6000 and 7000 prisoners of war in the circus; and when the senate, assembled in the Temple of Bellona, testified their horror at hearing the shrieks of the victims, he coldly said, 'Regard it not, fathers; it is only a few rebels who are punished by my orders.' Rome and all the provinces of Italy were filled with the most revolting scenes of cruelty. After satisfying his vengeance by the murder or proscription (see PROSCRIPTION) of several thousands, destroying all the cities of Samnium except three, and massacring the whole population of Praeneste, he celebrated a triumph exceeding in splendour any that had preceded it, and caused himself to be named dictator for an indefinite period (B.C. 81). He now ruled without restraint, repealed and made laws, abolished the tribuneship, took away the legislative and judicial functions of the plebeian *comitia tributa*, added 300 knights to the senate, admitted 10,000 slaves of persons proscribed to the rights of citizenship, and settled his veterans in different parts of Italy. In 79 B.C., to the astonishment of all, he laid down his dictatorship, and declared himself ready to answer for his actions. Retiring to Puteoli, and abandoning himself to all sorts of debauchery, he died the following year (78 B.C.), according to Plutarch's account, of a disgusting disease, occasioned by his excesses. Naturally insinuating and persuasive Sulla endeavoured in his youth to please universally. He spoke of himself with modesty, but was lavish of praises, and even of money, towards others. With the common soldiers he was familiar; he adopted their customs, drank with them, and partook of their amusements and hardships. At times he was severe, active, and vigilant, and impenetrable even to the companions of his excesses. He lent a ready ear to soothsayers and astrologers; and his character was stained by sensuality, avarice, and cruelty. Yet he had sufficient self-control to tear himself from his pleasures when ambition commanded. He was an able general and a great statesman; cruel, but faithful to his promises; calm and cold, but inflexible in his purposes. He sacrificed even his friends to the laws which he himself made and violated, and compelled his fellow-citizens to be better than himself. He ordered it to be inscribed on his tomb that no man had ever equalled him in doing evil to his enemies or in doing good to his friends.

**SULLY, MAXIMILIEN DE BÉTHUNE, DUC DE**, Marshal of France and first minister of Henry IV., one of the most estimable men that ever guided the helm of state. He was born at Rosny, near Mantes, of an ancient and noble family, in 1559 or 1560, and educated in the Protestant (Calvinistic) faith. At the age of eleven years he was presented by his father at the court of the Queen of Navarre, who in 1572 sent him with her son Henry (afterwards Henry IV.) to Paris to finish his education. During the massacre of St. Bartholomew's he was preserved by the president of the College of Burgundy, who concealed him for three days. When Henry, in 1576, made his escape from the French court the Baron de Rosny, as he was then styled, accompanied him, and in his service distinguished himself on several occasions by a bravery approaching to rashness. At Ivry (1590), where he took the standard of the Duke of Maine, he was most dangerously wounded. In 1592, being dissatisfied with the way in which he was treated by Henry, he retired to his estate and devoted himself to agriculture, but having obtained possession of some important papers revealing all the intrigues of the League, he hastened once more to Henry, who received him with open arms. He then, in spite of his attachment to Protestantism, coun-

seduced his sovereign to embrace the Catholic faith, seeing that that was the only way to strike a fatal blow at the League, and to save France. He afterwards visited the different provinces of the kingdom to win the towns for the king. In 1594 he received a place in the council of finance. In 1597 he was placed at the head of the department of finance, and two years after he had the title of superintendent conferred on him. He afterwards received various other offices and dignities. He was made superintendent of fortifications, buildings, ports, canals, and river navigation, grand-master of artillery, grand-surveyor of roads, governor of Poitou, of the Bastille, of Mantes, and of Jargeau. He was, in short, as he himself says, councillor of the king in all his councils; but it was in the department of finance that his administrative capacities were pre-eminently displayed. On entering on office he found the exchequer burdened with a debt of about 300,000,000 livres, but by rigid economy and by thorough reforms in the collection of the taxes he was able not only to meet the increased expenses of the new government, but also to pay off the state debt, remit to the people arrears of 20,000,000 livres, diminish the imposts by 6,000,000 annually, and deposit a large reserve in the Bastille. Though frequently thwarted in his purposes by the rapacity of the courtiers and mistresses of the monarch he nobly pursued his career, ever distinguishing himself as the zealous friend of his country, and not the temporizing minister of his master. His industry was unwearied. He rose every morning at four o'clock, and after dedicating some time to business he gave audience to all who solicited admission to him, without distinction of persons. He did all he could to encourage all branches of agriculture, which he regarded as the mainstay of the state. He introduced free trade in grain, abolished or reduced a large number of inter-provincial duties, opened in all directions great highways, commenced the canal of Briare, projected that of Languedoc, encouraged the draining of marshes and the working of mines. He was less favourable to manufacturing industries than to agriculture, thinking that they were prejudicial to the soldierly qualities of the people. In an embassy to England after the death of Queen Elizabeth (1603) he displayed great penetration and address, and concluded a treaty with James I. advantageous to the interests of both countries. In 1606 the territory of Sully-sur-Loire was erected into a duchy in his favour. In 1611, some months after the murder of Henry IV., he withdrew from court, and at the same time resigned most of his charges. The last years of his life were passed in retirement at Rosny and at Villebon, near Chartres. He occupied himself chiefly with agriculture, and only rarely appeared at court to give his advice on extraordinary occasions. In 1634 he received from Richelieu the staff of a marshal in exchange for the office of grand-master of the artillery. His death took place at Villebon, December 22, 1641. He left memoirs under the title of *Sages et Royales Economies d'Estat*, &c. (first complete edition, Amsterdam, 1728). They are written without method, and in a very heavy style, but are extremely valuable for the history of the reign of Henry IV.

**SULMONA**, or **SOLMONA** (ancient *Sulmo*), a town in middle Italy, about 72 miles east by north of Rome, picturesquely situated in a fertile plain 38 miles south-east of Aquila. It has several interesting churches and other buildings; a remarkable town-hall in the cinquecento style; and manufactures of paper, strings for musical instruments, and more especially confectionery. The poet Ovid was born here. Pop. 17,700.

**SULPHATES**, salts of sulphuric acid (which see). **SULPHIDES**, binary compounds of sulphur with other elements. See **SULPHUR**.

**SULPHITES**. See **SULPHUR**.

**SULPHONAL**, a drug of recent introduction, successfully employed for the production of sleep. It was first prepared by Prof. Baumann of Freiburg, and is of somewhat complex constitution. In doses of from 16 to 60 grains it produces a quiet natural sleep, from which the patient awakens refreshed in from 5 to 8 hours, with no disagreeable feeling or bad after-effects. In ordinary cases of sleeplessness, as well as in the sleeplessness of fevers, &c., it is prescribed with good results.

**SULPHUR**. Symbol S; atomic weight 32 (31.98). Sulphur has been known from remote antiquity, and was proved to be an element by Lavoisier (1772), and Gay-Lussac and Thenard (1809). As it usually occurs, it is a lemon-yellow crystalline solid, tasteless and odourless. It melts at 115° C. to a clear yellow liquid, at about 150° C. this begins to darken and thicken, and between 170° and 200° it is almost black and so thick that it will not pour. As the temperature rises it becomes liquid again, but retains the dark colour till it boils at 446° to a dark-red vapour. Sulphur is somewhat volatile at ordinary temperatures. According to Berthelot it is wholly volatilizable at a temperature far below its melting point. It becomes strongly negatively electrified when rubbed. It is a non-conductor of electricity, and is a very poor conductor of heat, and if a stick of sulphur be held in the hand it will soon begin to crack, the heat travelling so slowly that the outer layers expand and break away from the inner. It contracts very considerably on solidifying, so that there is usually a cavity in the centre of the stick, which is crossed by interlacing crystals.

Sulphur exists in at least four allotropic modifications; that is, forms which, while they consist only of sulphur, yet differ essentially in properties. They are classed in Watts' Dictionary as follows:—

(1) Insoluble in water:

- (a) Soluble in carbon disulphide.  $\alpha$ , or octahedral (rhombic) sulphur.  $\beta$ , or prismatic (monoclinic) sulphur. Amorphous sulphur.
- (b) Insoluble in carbon disulphide.  $\gamma$ , or plastic sulphur. Amorphous yellow sulphur.

(2) Soluble in water:

$\delta$ , or colloidal sulphur.

As these varieties differ very much they are best considered separately.

**$\alpha$ , or Octahedral (Rhombic) Sulphur.**—This is the common form, which is stable at ordinary temperatures. It is obtained in transparent octahedral crystals, belonging to the rhombic system, by crystallization from carbon disulphide, in which this form of sulphur is readily soluble. Its specific gravity is 2.03. When kept near its melting point the crystals become opaque, the sulphur passing into the  $\beta$  form.

**$\beta$ , or Prismatic (Monoclinic) Sulphur.**—When sulphur is solidified from fusion, it forms long needle-like prisms belonging to the monoclinic system. These are pale-yellow in colour, transparent, and soluble in carbon disulphide. Its specific gravity is 1.982. On standing, the crystals become opaque from a molecular change, the sulphur passing into the  $\alpha$  condition, whilst of course the crystals cannot change their external form; the change being facilitated by mechanical agitation, such as scratching the crystals.

**$\gamma$ , or Plastic Sulphur.**—This is a yellow body, soft and plastic. It can be drawn out into threads, or worked up into any form; but it very soon hardens

and becomes brittle. It is easily prepared by heating sulphur to near its boiling point, i.e. till it has passed through the viscid stage and again become plastic, and pouring it into cold water. When it becomes hard it consists of a mixture of soluble and insoluble sulphur, and the former can be removed by treatment with carbon disulphide.

When thiosulphates or polysulphides are decomposed by acids an amorphous precipitate is thrown down, which consists of a mixture of soluble and insoluble sulphur. The insoluble form slowly passes into the soluble form when heated to 100°.

**δ, or Colloidal Sulphur.**—When sulphuretted hydrogen is passed into a solution of sulphur dioxide at a little above 0° C., a milky liquid containing sulphur in suspension is obtained. If this be filtered and concentrated over caustic potash, KOH, in vacuo, a yellow solid is obtained, which is soluble in water. This form of sulphur does not seem to have been prepared pure, and it passes into the ordinary form on keeping.

**Chemical Properties.**—The chemical properties of sulphur will obviously vary with the form in which it is. All forms burn readily in air or oxygen with the formation of sulphur dioxide. The vapour density of sulphur varies with the temperature; just above boiling point it is about 96, giving a molecular formula of  $S_8$ , but at higher temperatures it becomes 32, giving a molecular formula of  $S_2$ . It is oxidized by powerful oxidizing agents, such as nitric acid or aqua regia, yielding sulphuric acid. Fused with solid paraffins it evolves hydrogen sulphide, and when boiled with water at 100°, hydrogen sulphide is evolved. It combines readily with most of the metals, especially at high temperatures, forming sulphides, most of which are readily fusible.

**Occurrence in Nature.**—Sulphur occurs in nature both in the combined and in the free state. Free sulphur occurs generally in volcanic districts, in some of which it is constantly being formed by reactions between the evolved gases, such as sulphuretted hydrogen and sulphur dioxide,  $H_2S + 2SO_2 = H_2O + 3S$ , or by the action of oxygen on sulphuretted hydrogen in contact with ferric oxide or other substances,  $H_2S + O = H_2O + S$ . The sulphur occurs intermixed with stony or earthy matter, in more or less crystalline masses, sometimes with abundance of distinct crystals of octahedral sulphur. The principal volcanic districts which yield sulphur are those of Italy and Sicily, large quantities being exported from the latter. Free sulphur also occurs in stratified deposits, intermixed with earthy or calcareous matter, sometimes containing 40 per cent of sulphur. These have probably been formed by complex chemical reactions between gases and solutions, but the origin has not been made out with certainty. Such deposits occur in various parts of the world, and are worked in many places, the most important deposit probably being that of the Yellowstone district of the Rocky Mountains. Beds of nearly pure sulphur, upwards of 100 feet thick, have recently been found by boring in Louisiana. Sulphur is evidently abundant in the earth's crust, because the stable minerals at depths are almost always sulphides; and as there will always be water circulating through the rocks and the temperature will be high, reactions may take place by which sulphur may be separated.

Sulphur is very abundant in the form of sulphides, most metals occurring in that form; but the only sulphide used on a large scale as a source of sulphur is iron pyrites ( $FeS_2$ ), which is usually called sulphur ore. Sulphates also occur in nature, but as they are nearly all soluble in water they are not so abundant as the less-soluble sulphides.

**Preparation of Sulphur.**—Sulphur is usually ob-

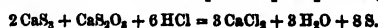
tained from native sulphur by lixivation, distillation, or solution. Lixivation methods are based on the fact that sulphur is readily fusible, whilst the earthy materials with which it is associated are infusible. The oldest form of this method was to make the ore into piles and ignite it. Part of the sulphur, that near the surface to which air could get access, was burnt, and the heat of its combustion melted that in the centre of the heap, which ran down into a cavity made to receive it. This process is still used; it is, however, very wasteful, the yield of sulphur being small, but it is very cheap and easy to work. The crude sulphur may be melted in pots, the earthy matter sinking to the bottom, the liquid sulphur is ladled off into moulds; and in a modern process used mainly in America, the ore is charged into a furnace not unlike a cupola in form, and is there heated with steam at a temperature of about 111° C., by which the sulphur is melted, and, running down, is collected in a suitable receiver.

In the distillation processes the earth is heated above the boiling point of the sulphur, which distils out and is condensed in suitable receivers. In some districts earthen pots are used, the vapour being condensed either in earthen pots or in large brick chambers.

In the solution process the sulphur is dissolved in a solvent, usually carbon disulphide, from which it is afterwards recovered. This method is not used on the large scale.

From pyrites ( $FeS_2$ ) sulphur may be obtained by simple distillation, thus  $3FeS_2 = Fe_2S_3 + 2S$ , but this process is not used.

Many attempts have been made to recover sulphur from alkali waste (see *SODA*), but the only process that need be mentioned is that of Mond. The waste, which contains calcium sulphide, is oxidized by blowing air through it for several hours, and is then leached with water. The solution obtained contains a mixture of polysulphides of calcium and calcium hyposulphite, and on addition of hydrochloric acid, if the oxidation has been properly conducted, the whole of the sulphur is precipitated, thus



Sulphur comes into the market in several forms. *Stick sulphur*, or brimstone, is made by melting the sulphur and casting into sticks in wooden moulds. *Flowers of sulphur* is made by distilling crude sulphur and condensing the vapour in large chambers kept cool, so that the temperature does not rise to the melting point. *Milk of sulphur* is made by boiling lime and sulphur together, whereby a dark-yellow solution of a polysulphide of calcium is obtained. This is filtered from the excess of lime and acidified, when a white amorphous precipitate of sulphur is thrown down. When sulphuric acid is used the sulphur is mixed with calcium sulphate, often in considerable quantity.

**Uses.**—The uses of sulphur are many. It is used for the preparation of sulphuric acid (brimstone vitriol—see next article), for the preparation of sulphur dioxide for bleaching and other purposes, for the preparation of certain sulphides for vulcanizing india-rubber, for the manufacture of gunpowder, for dressing vines, and for many other purposes; and milk of sulphur is used in medicine.

**Sulphur Hydrides.**—Sulphur forms two compounds with hydrogen, only one, hydrogen sulphide, being of any importance.

**Hydrogen Sulphide** (sulphuretted hydrogen, hydrosulphuric acid),  $H_2S$ .—This is a colourless gas, having a most unpleasant odour. It is slightly heavier than air, and is soluble in water, 1 volume of water at 15° C. dissolving 8.23 volumes of the

gas, forming a solution which is known as sulphuretted hydrogen water. The gas under a pressure of 17 atmospheres is condensed to a colourless liquid which boils at  $-61.8^{\circ}\text{C}.$ , and freezes to a white solid at  $-85^{\circ}\text{C}.$

The gas is decomposed when passed through a red-hot tube, and is readily decomposed by oxidizing agents. Heated with tin, tin sulphide is formed and hydrogen liberated, the hydrogen occupying the same volume as the original gas.

The gas burns readily in air, with a pale-blue flame, water and sulphur dioxide being formed, or, if the quantity of air be limited, sulphur being separated. With air or oxygen it forms an explosive mixture. It is decomposed by sulphur dioxide, and it attacks many metals, *e.g.* silver, which it blackens rapidly. It is decomposed by strong sulphuric acid, which, therefore, cannot be used for drying it ( $\text{H}_2\text{SO}_4 + \text{H}_2\text{S} = \text{S} + 2\text{H}_2\text{O} + \text{SO}_2$ ), and it is decomposed by chlorine and most oxidizing agents. It is a powerful poison. The solution is unstable; and on exposure to the air decomposes with separation of sulphur ( $\text{H}_2\text{S} + \text{O} = \text{H}_2\text{O} + \text{S}$ ).

Hydrogen sulphide occurs among the gases evolved from volcanoes, and in solution in many mineral waters. It can be prepared by passing dry hydrogen over some sulphides or through boiling sulphur, or by heating sulphur with solid paraffin, aniline, or some other organic bodies, or by treating some sulphides with acid. When required for laboratory use it is always prepared by the action of hydrochloric or sulphuric acid on the sulphide of iron ( $\text{FeS}$ ), prepared by melting together iron and sulphur ( $\text{FeS} + 2\text{HCl} = \text{H}_2\text{S} + \text{FeCl}_2$ ), or by heating antimony sulphide ( $\text{Sb}_2\text{S}_3$ ) with strong hydrochloric acid.

When organic substances containing sulphur, such as egg albumen, decay, hydrogen sulphide is given off, so that the unpleasant smell of rotten eggs is due to it. It is largely used in the laboratory as a precipitant, since it forms insoluble sulphides when passed into the solutions of many metals.

*Hydrogen persulphide* ( $\text{H}_2\text{S}_2$ ) is a heavy oily liquid with an unpleasant odour and taste. It spontaneously decomposes into  $\text{H}_2\text{S}$  and  $\text{S}$ , and is of no importance.

*Sulphides*.—Compounds of other elements with sulphur are called sulphides. They may be regarded as salts of hydrogen sulphide (sulphydric acid), the hydrogen being replaced by a metal. The sulphides may be divided into two groups: the first, containing those of silver, lead, mercury, copper, bismuth, tin, arsenic, antimony, cobalt, and nickel, are insoluble in dilute hydrochloric acid; the rest are soluble, cadmium sulphide being a link between the two.

The sulphides of the alkaline and alkali earth metals are soluble in water. Soluble sulphides are decomposed on solution in acids, hydrogen sulphide being evolved; the other sulphides are attacked by strong acids—mercury sulphide only by aqua regia—with separation of sulphur. When hydrogen sulphide is passed through solutions containing metallic salts acidified with hydrochloric acid, some sulphides are precipitated. Lead sulphide,  $\text{PbS}$  (black); mercury sulphides,  $\text{Hg}_2\text{S}_2$  and  $\text{HgS}$  (black); silver sulphide,  $\text{Ag}_2\text{S}$  (black); copper sulphide,  $\text{CuS}$  (black); bismuth sulphide,  $\text{Bi}_2\text{S}_3$  (black); cadmium sulphide,  $\text{CdS}$  (yellow); arsenic sulphide,  $\text{As}_2\text{S}_3$  (yellow); stannous sulphide,  $\text{SnS}$ ; stannic sulphide,  $\text{SnS}_2$ ; and antimony sulphide,  $\text{Sb}_2\text{S}_3$  (orange-red). The four last named are soluble in alkaline sulphides or hydrates. Great use is made of these precipitations in chemical analysis.

Many sulphides show a great tendency to combine and form double sulphides; for example, sul-

phides of antimony, arsenic, and tin combine with sulphides of the alkaline metals and form double sulphides, which are soluble.

Sulphides can be prepared by precipitation, as above, by heating the metals with sulphur, by heating metallic oxides with excess of sulphur, and by reducing sulphates.

Many sulphides occur in nature; indeed, in the case of most metals the sulphides are the stable mineral forms. Double sulphides are common, and in some cases the natural sulphides differ in composition and properties from those obtained artificially. Most of the sulphides which occur in nature are described under the respective metals.

*Sulphide of Carbon* (carbon disulphide),  $\text{CS}_2$ .—This body corresponds in composition to carbon dioxide. It is a colourless, very volatile liquid, having a most unpleasant odour. It is easily inflammable. It dissolves fats, resins, and other substances, and is used in the arts as a solvent. It is prepared by heating sulphur and carbon to a high temperature and condensing the distillate, and it may be purified by distillation over quicklime. It combines with many metallic sulphides to form salts known as thio-carbonates, *e.g.*  $\text{Na}_2\text{S} + \text{CS}_2 = \text{Na}_2\text{CS}_3$ . Another sulphide, carbon monosulphide ( $\text{CS}$ ), is said to have been obtained as a red powder, but it is of no importance.

*Chlorides of Sulphur*.—Three compounds of chlorine and sulphur are known,  $\text{S}_2\text{Cl}_2$ ,  $\text{SCl}_2$ , and  $\text{SCl}_4$ . They are all liquids and of little importance. The most stable is the monochloride,  $\text{S}_2\text{Cl}_2$ , which can be prepared by passing chlorine into a flask containing sulphur at a moderate temperature, till nearly, but not quite, all the sulphur is dissolved, and distilling off the liquid. It is a yellowish-red oily liquid, which fumes in air, having a specific gravity of 1.7094, and boiling at  $138^{\circ}$ . It is used in the vulcanizing of india-rubber, the article to be treated being exposed to the vapour of the chloride.

*Oxides of Sulphur*.—Sulphur forms two oxides,  $\text{SO}_2$  and  $\text{SO}_3$ , both of them being anhydrides; *i.e.* forming acids when passed into water.

*Sulphur Dioxide* (sulphurous anhydride),  $\text{SO}_2$ .—This oxide is readily formed by burning sulphur in air. It is a colourless gas having a suffocating odour, the well-known odour of burning sulphur. It is heavy, having a specific gravity 2.22 (air=1). It is condensed to a liquid by the cold produced by a mixture of ice and salt, or by a pressure of 2.5 atmospheres, and is therefore one of the most easily condensed of the gases, and the liquid freezes at  $-76^{\circ}\text{C}.$  It is very soluble in water, water dissolving at  $0^{\circ}\text{C}.$  79.282 times its volume of the gas, and this is expelled from solution by long-continued boiling. The solution has a distinctly acid reaction, and contains the acid  $\text{H}_2\text{SO}_3$ , the pure dry gas having no action on test-paper. By cooling a saturated solution of the gas definite crystals,  $\text{H}_2\text{SO}_3 \cdot 14\text{H}_2\text{O}$ , are obtained. It is a powerful reducing agent, taking up oxygen readily; it is a powerful antiseptic, and bleaches vegetable colours. The bleaching by sulphur dioxide is due to a reducing action, the colour being sometimes restored by the action of oxidizing agents.

Sulphur dioxide is oxidized by most oxidizing agents, and it is decomposed by hydrogen sulphide. The gas is readily prepared by burning sulphur in air, this method being largely used for disinfecting and bleaching purposes where the pure gas is not required. In place of sulphur, iron pyrites ( $\text{FeS}_2$ ) may be used, the pyrites being contained in a kiln, and air passed over it. This is the method used in the preparation of sulphur dioxide for the manufacture of sulphuric acid. When the gas is required on a small scale it is almost always prepared in one

of two ways: (1) by the action of dilute acids on sodium sulphite, *e.g.*  $\text{Na}_2\text{SO}_3 + \text{H}_2\text{SO}_4 = \text{Na}_2\text{SO}_4 + \text{SO}_2 + \text{H}_2\text{O}$ ; or (2) by treating hot strong sulphuric acid with a metal which is soluble in it, such as copper or silver, or with some reducing agent, such as sulphur or carbon. In the former case one molecule of acid forms sulphate with the metal, and the hydrogen which would be liberated attacks more of the acid and reduces it, *e.g.*  $\text{Cu} + 2 \text{H}_2\text{SO}_4 = \text{CuSO}_4 + \text{SO}_2 + 2 \text{H}_2\text{O}$ ; whilst in the case of a reducing agent this decomposes the acid,  $\text{S} + 2 \text{H}_2\text{SO}_4 = 2 \text{H}_2\text{O} + 2 \text{SO}_2$ .

Liquid sulphur dioxide is now prepared in large quantity by evolving the gas by any of the above-mentioned methods and passing it through a freezing-mixture; and it is sent into the market in siphons.

Sulphur dioxide is used for many purposes: for instance, as a bleaching agent, in bleaching silk, straw, wool, and other substances that might be injured by the action of chlorine. It is frequently used as a disinfectant, being usually prepared for this purpose by burning sulphur. It is used for the treatment of fur, wool, and hair so as to facilitate felting in the manufacture of felt, by paper-makers in the treatment of wood pulp, as an antichlor for the removal of the last traces of chlorine from goods which have been bleached with that agent, in sugar-refining, and for many other purposes. The most important use is in the manufacture of sulphuric acid (which see).

**Sulphurous Acid.**—When sulphur dioxide is dissolved in water an acid solution is produced which contains sulphurous acid. The acid has, however, never been isolated, as on heating the solution, or even evaporating in vacuo, sulphur dioxide is given off.

Three series of salts are derived from sulphurous acid, the normal salts  $\text{R}_2\text{SO}_3$ , the acid salts or bisulphates  $\text{RHSO}_3$ , and the metasalts  $\text{R}_2\text{S}_2\text{O}_5$ . The sodium salts belonging to each group, which are the most important, are described under SODA.

The sulphites are all soluble in water, and are all decomposed by acids, sulphur dioxide being evolved. In solution they oxidize readily, being converted into sulphates. They absorb sulphur dioxide with the formation of metabisulphites (see SODA).

Salts are known derived from several other sulphur acids, which, however, are of very little importance: such as hyposulphites from hyposulphurous acid,  $\text{H}_2\text{S}_2\text{O}_4$ ; the thionates and dithionates from thionic or dithionic acid,  $\text{H}_2\text{S}_3\text{O}_6$ ; the trithionates, tetrathionates, and pentathionates from tri-, tetra-, and penta-thionic acids,  $\text{H}_2\text{S}_4\text{O}_8$ ,  $\text{H}_2\text{S}_5\text{O}_{10}$ ,  $\text{H}_2\text{S}_6\text{O}_{12}$ .

**Thiosulphuric Acid** ( $\text{H}_2\text{S}_2\text{O}_3$ ).—This acid has never been isolated, as it undergoes spontaneous decomposition. When a solution of sodium thiosulphate is acidified with dilute hydrochloric acid the solution remains clear for a short time, and then no doubt contains free thiosulphuric acid, but this very soon splits up into sulphurous acid and sulphur ( $\text{H}_2\text{S}_2\text{O}_3 = \text{H}_2\text{SO}_3 + \text{S}$ ), the solution becoming turbid and smelling strongly of sulphur dioxide.

The thiosulphates, commonly called hyposulphites, are the salts derived from this acid. The most important is the sodium salt (see SODA). The thiosulphates of the alkalis and the alkaline earths are soluble, the remainder are insoluble. They are all decomposed by acids. They are converted into tetrathionates by free iodine ( $2 \text{Na}_2\text{S}_2\text{O}_3 + 2 \text{I} = \text{Na}_2\text{S}_4\text{O}_8 + 2 \text{NaI}$ ), whilst potassium permanganate in acetic acid solution converts them into dithionates.

When copper sulphate is added to a solution of sodium thiosulphate in the cold, a colourless solution is produced which contains cuprous thiosulphate, or

perhaps the acid salt  $\text{Cu}_2\text{H}_2(\text{S}_2\text{O}_3)_2$ , since this can be obtained as yellow crystals. This solution is used for dissolving silver in the Russell process of silver extraction, and is known as 'extra solution'. On heating to boiling the solution is decomposed and cuprous sulphide is precipitated.

**Sulphur trioxide** (sulphuric anhydride),  $\text{SO}_3$ .—This is a white crystalline solid melting at  $14.8^\circ \text{C}$ ., and boiling at  $46.2^\circ \text{C}$ ., so that at ordinary temperatures it may be either solid or liquid according as the temperature is above or below  $14.8^\circ \text{C}$ . It crystallizes in long white needles. It must be kept in sealed tubes, as it absorbs water with extreme avidity, and when thrown into water combines with it with great evolution of heat. It is excessively poisonous and caustic, and does not redden litmus paper. With water it at once forms sulphuric acid.

It can be prepared by the oxidation of sulphur dioxide under suitable conditions, though, if merely mixed, oxygen and sulphur dioxide do not unite. Ozone, however, brings about the combination, and if a mixture of sulphur dioxide and oxygen be passed over heated spongy platinum combination takes place readily; certain oxides, such as ferric oxide, also bring about combination, but to a less marked extent. Many sulphates and bisulphates when heated yield sulphur trioxide, and it may be obtained by distilling Nordhausen sulphuric acid (which see). Two other oxides of sulphur are known, but these are of little importance. They are sulphur sesquioxide ( $\text{S}_2\text{O}_3$ ), which is a blue-green solid, and may be regarded as being the anhydride of hyposulphurous acid and sulphuric peroxide ( $\text{S}_2\text{O}_7$ ), a white solid closely resembling  $\text{SO}_3$  in appearance. It is the anhydride of persulphuric acid (see SULPHURIC ACID).

**SULPHURETTED HYDROGEN.** See preceding article.

**SULPHURIC ACID** (OIL OF VITRIOL),  $\text{H}_2\text{SO}_4$ .—This is the hydrate of sulphur trioxide. (See SULPHUR.) It melts at  $10.5^\circ \text{C}$ . and begins to boil at  $290^\circ \text{C}$ ., but at that temperature undergoes partial decomposition, the temperature gradually rising to  $380^\circ \text{C}$ ., when the acid breaks up into sulphur trioxide and water. It is a clear, colourless, oily liquid, having a very strong acid reaction. It is a violent corrosive poison, it fumes slightly in air, and absorbs water with great readiness and with the evolution of a large amount of heat. It attacks most metals, some only when hot and concentrated, in which case the greater portion of the acid is decomposed and sulphur dioxide is evolved, and others when dilute in the cold, hydrogen being evolved. At high temperatures it acts as oxidizing agent, oxidizing sulphur to sulphur dioxide, and carbon to carbon dioxide, and it chars organic matter owing to the avidity with which it absorbs water.

The commercial acid always contains water, and as the more water it contains the lighter it becomes, the specific gravity is a measure of the amount of acid actually present. The following abridged table will give an idea of the relationship existing between specific gravity and amount of acid:—

Sp. Gr.	Per cent $\text{H}_2\text{SO}_4$ .	Sp. Gr.	Per cent $\text{H}_2\text{SO}_4$ .	Sp. Gr.	Per cent $\text{H}_2\text{SO}_4$ .
1.081	5	1.307	40	1.733	80
1.069	10	1.299	50	1.818	90
1.147	20	1.503	60	1.840	95
1.224	30	1.615	70	1.838	100

Sulphuric acid has been manufactured on a very large scale, and the method now in use has been known for a long time, the great improvement having been made by Roebuck in 1746, by substituting lead vessels for glass.

In outline the process is as follows:—Sulphur dioxide is prepared by burning sulphur. This is passed into lead chambers, where it is oxidized by the action of nitric acid, and the dilute acid thus obtained is concentrated by evaporation. It will only be possible to give the briefest possible account of the process.

**Raw Material.**—The raw material is almost invariably iron pyrites,  $\text{FeS}_2$  (sulphur ore), which contains when pure 53.3 per cent of sulphur. The pyrites usually used in this country is imported from Spain, and contains small quantities of copper and silver, which are afterwards recovered, and also arsenic and other impurities which pass into the acid. Sometimes sulphur is used, the acid so made being called brimstone vitriol. This is usually purer than pyrites vitriol, but is by no means always quite free from arsenic, as native sulphur may contain that element.

**Burning.**—The pyrites is burnt in kilns. No fire is needed, as the heat evolved by the combustion of the sulphur is sufficient to keep the burning going on. The kilns are usually brick chambers provided with fire-bars on which the pyrites rests, so that they may be regarded as being large fire-places. In ordinary burners only lumps of say over  $\frac{1}{2}$  inch diameter can be burned. For burning the smaller material ('smalls') many forms of burner have been designed.

**Nitric Acid.**—The oxidizing agent used is nitric acid, and this is prepared from sodium nitrate and sulphuric acid,  $2 \text{NaNO}_3 + \text{H}_2\text{SO}_4 = 2 \text{NaHSO}_4 + 2 \text{HNO}_3$ . The mixture is put into cast-iron pots, which are simply deep trays, and these are put into a chamber in the flue which connects the kiln with the lead chamber, so that the heat of the gases causes the reaction to take place, and the acid is carried forward into the lead chambers. The necessary steam is supplied to the chambers from suitably placed boilers.

**The Lead Chambers.**—The chambers are built of sheet-lead, about 6 lbs. per square foot, supported outside by a strong framework of timber, which may be boarded so as to protect the chamber from the weather, but which is usually left open. The chambers are carried on brick or stone piers or iron columns so as to leave space underneath; they are 100 to 130 feet long, 25 to 30 feet wide, and 16 to 20 feet high, having therefore a capacity of 40,000 to 80,000 cubic feet, a set of chambers often being arranged in series. The size and arrangement of the chambers, however, vary much. The plates of which the chamber is composed must be united by autogenous soldering—that is, they are fused together without the use of any solder; the lead must be very pure and free from zinc (chemical lead), and is always, therefore, desilverized by the Pattinson process. Sometimes the chamber forms a complete box, but more usually the tops and sides form one portion and the bottom is separate, and is made with turned-up edges so as to form a sort of saucer 12 or 15 inches deep, this being filled with acid, into which the sides dip so as to form a seal.

**Chemical Reactions.**—The changes which take place are complex, and as to their details somewhat uncertain, many different views having been held as to what takes place within the chamber. The following may be taken as a fair outline of the probable reactions:—The nitric acid is swept forward into the chamber, and is acted on by the sulphur dioxide,  $2 \text{HNO}_3 + 3 \text{SO}_2 + 2 \text{H}_2\text{O} = 3 \text{H}_2\text{SO}_4 + 2 \text{NO}$ , or  $2 \text{HNO}_3 + 2 \text{SO}_2 + \text{H}_2\text{O} = 2 \text{H}_2\text{SO}_4 + \text{N}_2\text{O}$ . The nitric oxide is then acted on by the oxygen of the air, forming nitrous anhydride,  $2 \text{NO} + \text{O} = \text{N}_2\text{O}_2$ , and this in its turn acts on more sulphur dioxide,

forming more sulphuric acid, and being reduced to nitric oxide,  $\text{N}_2\text{O}_2 + \text{SO}_2 + \text{H}_2\text{O} = \text{H}_2\text{SO}_4 + 2 \text{NO}$ , which will then be reoxidized, and can start the series of actions over again. The nitrous oxide, therefore, is not used up, but merely acts as an oxygen carrier, and the amount of sulphuric acid made is not necessarily proportional to the amount of nitric oxide present.

When the quantity of water is insufficient, white crystals of nitrosyl-sulphuric acid (chamber crystals) are formed, which are decomposed by water, forming sulphuric acid; and some authorities think that this substance is always formed as a stage in the production of the acid, thus— $2 \text{SO}_2 + 3 \text{N}_2\text{O}_2 + \text{H}_2\text{O} = 2 \text{SO}_2(\text{OH})(\text{NO}) + 4 \text{NO}$ .  $2 \text{SO}_2(\text{OH})(\text{NO}) + \text{H}_2\text{O} = 2 \text{H}_2\text{SO}_4 + \text{N}_2\text{O}$ . The acid formed falls to the bottom of the chamber, and is mixed with a large quantity of water from the condensed steam.

**Gay-Lussac Tower.**—The gases leaving the chamber will necessarily carry away a considerable quantity of nitrous gases, and these may be recovered by means of the Gay-Lussac tower. The tower is usually of sheet-lead, sometimes lined with fire-brick, and is packed full of hard coke. The gases enter the bottom, and as they ascend are met by a descending stream of fairly strong vitriol, which dissolves out the nitrous gases, forming nitrosyl-sulphuric acid.

**The Glover Tower.**—The nitrated vitriol is useless. It must therefore be denitrated, and the nitrous gases recovered for re-use. This is done in the Glover tower. The tower is 20 to 30 feet high, lined with sheet-lead, with an inner lining of fire-brick, and is packed with flints, bricks, or similar material. Nitrated acid and weak chamber acid are distributed at the top of the tower, whilst the hot gases on their way from the pyrites burners to the chambers enter at the bottom. The dilution decomposes the nitrosyl-sulphuric acid, and the liberated nitrous gases are carried forward to the chambers. At the same time the hot gases passing upward carry away the water, and thus concentrate the acid. The concentrated tower acid is cooled, and may be used in the Gay-Lussac tower.

**Concentration.**—The weak chamber acid must be concentrated before it can be sent into the market. The concentration is partly carried out in the Glover tower, but other portions of the acid are evaporated in lead pans till the acid becomes strong enough to seriously attack the lead. In some cases the pans are heated from below, in others from above, waste heat being usually used; and various other methods of evaporation have been suggested.

To obtain concentrated acid, the weak acid is put into glass, or more often platinum, stills, which are heated over fires till most of the water has been expelled, and as some acid is carried over, the vapours are condensed and the weak acid thus obtained is concentrated. The strong acid, which may contain 98 per cent  $\text{H}_2\text{SO}_4$ , remains in the retort, and is the oil of vitriol of commerce. Brown oil of vitriol (B-O-V) is a weaker acid, not concentrated in retorts, and brown from the presence of organic matter, which is charred by the sulphuric acid. A continuous system of concentration is now often used.

**Purification.**—Arsenic may be removed by passing sulphuretted hydrogen through the chamber acid, or, where the presence of sulphates will not be objectionable, by addition of sodium sulphide, the arsenic being precipitated as yellow arsenious sulphide. Nitrous fumes, if present, must be removed before distillation in platinum retorts, and this is done by addition of ammonium sulphate and heating. Lead may be removed by diluting the acid, when lead sulphate precipitates. Non-volatile im-

purities may be separated by distilling and condensing the strong acid.

**Fuming Sulphuric Acid** (Nordhausen acid).—This is still prepared by the method that has been in use for centuries, viz. distilling ferrous sulphate (green vitriol). The salt is dried so as to expel most of the water of crystallization, and is then distilled in clay retorts, the acid which passes over being condensed,  $2\text{FeSO}_4 = \text{Fe}_2\text{O}_3 + \text{SO}_3 + \text{SO}_2$ . The quantity of water present being insufficient to convert the sulphur trioxide into sulphuric acid, the excess remains dissolved, forming fuming acid. The strongest acid that can be made has the formula  $\text{H}_2\text{SO}_4\text{SO}_3 = \text{H}_2\text{S}_2\text{O}_7$ . Other sulphates may be used, such as sodium bisulphate,  $\text{NaHSO}_4$ . This is first heated to expel water and form the pyrosulphate  $\text{Na}_2\text{S}_2\text{O}_7$ , which on further heating yields sulphur trioxide and sodium sulphate, so that the cycle of changes would be: (1)  $\text{Na}_2\text{SO}_4 + \text{H}_2\text{SO}_4 = 2\text{NaHSO}_4$ , (2)  $\text{NaHSO}_4 = \text{Na}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O}$ , (3)  $\text{Na}_2\text{S}_2\text{O}_7 = \text{Na}_2\text{SO}_4 + \text{SO}_3$ . Many attempts have been made to prepare the acid on a large scale by passing sulphur dioxide and air over hot spongy platinum.

**Sulphates.**—Sulphuric acid forms two series of salts—the normal sulphates, such as  $\text{Na}_2\text{SO}_4$ , and the acid sulphates, such as  $\text{NaHSO}_4$ . The normal sulphates are nearly all soluble in water or acids, those of Ba, Sr, Pb being insoluble, and those of Ca and Ag slightly soluble. The acid sulphates are nearly all soluble, and there are many basic sulphates which are insoluble. The sulphates are all decomposed by heat, but with very varying degrees of readiness, oxides being left, and in general sulphur trioxide being evolved, and they are decomposed by fusion with carbon, sulphides being formed. Sulphates are readily prepared by the solution of oxides in sulphuric acid, and by roasting or otherwise oxidizing sulphides. A few, e.g.  $\text{CaSO}_4$ ,  $\text{BaSO}_4$ ,  $\text{PbSO}_4$ , and others, occur in nature.

**Pyrosulphuric Acid** ( $\text{H}_2\text{S}_2\text{O}_7$ ).—A solution of this acid in sulphuric acid is the Nordhausen or fuming sulphuric acid already mentioned. The acid can be obtained by adding sulphur trioxide to sulphuric acid, and drying over strong sulphuric acid. It forms large crystals, which melt at  $35^\circ$ . It is decomposed by water, which it absorbs readily. Pyrosulphates can be obtained in some cases by gently heating acid sulphates (see above).

**Persulphuric Acid** ( $\text{H}_2\text{S}_2\text{O}_8$ ).—This acid has only been obtained in solution. Its anhydride,  $\text{S}_2\text{O}_8$ , has already been mentioned.

**Persulphates.**—Only a few of these salts have been obtained, and the only one made commercially is the ammonium persulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ , which is used to some extent in photography as a reducing agent, i.e. for dissolving out the silver image.

**Derivatives of Sulphuric Acid.**—If the formula of sulphuric acid be written  $\text{SO}_2(\text{OH})_2$  it will be seen that derivatives can be obtained by replacing one or both the OH groups. When one OH group is replaced the body is called a sulphonic acid, as it still retains acid properties. Such bodies are chlorosulphonic acid,  $\text{SO}_2\text{OHCl}$ ; amidosulphonic acid,  $\text{SO}_2\text{OHNH}_2$ ; fluosulphonic acid,  $\text{SO}_2\text{OHF}$ ; nitrosulphonic acid,  $\text{SO}_2\text{OHNO}$  (chamber crystals); and many others, and each of these acids can give rise to a series of salts. When both the OH groups are replaced, sulphuryl compounds are produced, thus  $\text{SO}_2\text{Cl}_2$ , sulphuryl chlorides, &c. Similar derivatives are obtained from sulphurous and other sulphur acids.

**SULPHURIC ETHER.** When one part of ethylic alcohol is heated to about  $140^\circ\text{C}$ . with one or two parts of strong sulphuric acid, in a vessel connected with a condensing apparatus, a mobile liquid

distils over with a peculiar fruity intoxicating odour. If a slow stream of alcohol be allowed to flow into the vessel the production of this mobile liquid may be maintained for a long time without the addition of fresh quantities of sulphuric acid. If, however, the temperature be allowed to rise much above  $140^\circ\text{C}$ . secondary reactions are brought about, which result chiefly in the formation of ethylene and sulphurous acid.

The first product of the action of sulphuric acid upon alcohol under the above-mentioned conditions appears to be a substance called *ethyl sulphuric acid* (or *sulphovinic acid*), thus—



but this substance is quickly decomposed by the further action of alcohol, with the production of ether and re-formation of sulphuric acid—



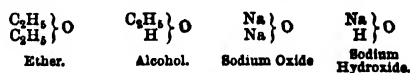
The freshly-formed sulphuric acid again reacts upon another quantity of alcohol, with the production of ethyl sulphuric acid and subsequently of ether. The process is therefore continuous.

In practice it is found that the sulphuric acid is apt to retain a portion of the water produced, as in equation (1) above, and thus to become gradually more and more diluted until it is unable to effect the decomposition of the alcohol; for this reason small quantities of strong acid are from time to time added.

Sulphuric ether (as it is commonly called, because of the method by which it is prepared), or ethylic ether, may be regarded as a compound formed upon the water type (see TYPES) by the substitution of the radicle  $\text{C}_2\text{H}_5$ , for the two hydrogen atoms of water. This body is thus comparable with the oxides of the alkali metals.

Thus as we have  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{O}$ ,  $\text{Li}_2\text{O}$ , &c.;  
So we have.....  $(\text{C}_2\text{H}_5)_2\text{O}$ .

Looked at in this light, ether stands in the same relation to alcohol as sodium oxide does to sodium hydroxide:—



Ether seems to have been first prepared by Valerius Cordius in 1540; the name of ether was applied to it by Frobenius in 1730, while that of sulphuric ether was given a little later.

To Williamson we owe the explanation of the process of etherification which is now generally adopted.

The product obtained by the process sketched above always contains alcohol and water, &c., in addition to ether; it is purified by shaking with milk of lime, allowing the ether to rise to the surface, running off the lower liquid, and again distilling the separated ether.

Pure ether is a colourless, mobile liquid, having a peculiar intoxicating odour, and a sharp, burning taste. It has a specific gravity of  $0\cdot728$  at  $12\cdot5^\circ\text{C}$ . it boils at  $35\cdot5^\circ\text{C}$ . At  $-81^\circ\text{C}$ . it crystallizes in shining plates. Ether is very inflammable; a mixture of air and ethereal vapour explodes with great violence when brought into contact with a burning body; on account of the great volatility of ether it should be handled with the utmost care, and never poured from vessel to vessel in a room where a light is burning.

Ether, by its spontaneous evaporation, produces a great degree of cold; if a few drops of this liquid be placed in a watch-glass standing upon a block of wood, and having a drop of water on its convex side, and if the ether be caused to evaporate quickly by blowing

dry air over its surface, cold is produced sufficient to freeze the water, and so to fix the watch-glass to the block.

Ether is used in the form of spray for producing great cold, and consequent insensibility to pain of the part, during minor surgical operations.

A large series of derivatives may be produced from ether. See the article ETHERS.

**SULPHUROUS ACID.** See SULPHUR.

**SULTAN**, in Arabic, signifies monarch, ruler. The title is borne by various Mohammedan rulers, while the Turkish emperor assumes the title of Sultan-es-selatin, 'Sultan of sultans'. The daughters of the sultan have also the title of sultan. The title of sultana is given out of Turkey to the chief concubines of the sultan, but no such title is in use for them in Turkey. If the mother of the Sultan is living she is styled *sultan Valide*.

**SULTANABAD**, a town of Persia, prov. of Irak-Ajemi, in a well-watered valley. Founded early in the nineteenth century it is a thriving place, with important manufactures of carpets. Pop. 20,000.

**SULU ISLANDS**, an island group in the Indian Archipelago, between the Mindoro or Sulu Sea on the north, the Celebes Sea on the south, the island of Borneo on the south-west, and that of Mindanao on the north-east. It consists of more than 150 islands, most of them very small, and many of them coral reefs. They are divided into three groups, named respectively after the three principal islands, Basilan in the north-east, Sulu in the centre, and Tawee-Tawee in the south-west. The area of the whole is estimated at 1600 square miles. The inhabitants are adherents of Islam, having been converted to that faith at a distant period through their commercial intercourse with the Arabs. Their whole worship, however, consists in nothing more than the observance of a few unimportant customs. The islands are fertile, and produce all kinds of tropical plants and trees; but the only articles of value for export are birds' nests and pearls, in which the islands are very rich. The pearls are said, however, to lose their brilliancy with the lapse of time. A large amount of ambergris is thrown up on their shores by the west monsoon, although that substance is not found on the neighbouring islands. The Chinese and the Indians are the principal traders with these islands. The Sulus themselves trade to Borneo and Mindanao, whence they bring sago, cowries, rice, &c. The Sulu Archipelago used to be under the sway of a sultan, who recognized Spain as his suzerain, but after the Spanish-American war it passed under the sovereignty of the United States. The inhabitants are of Malay origin. Their number is estimated at 150,000.

**SUMACH** (*Rhus*), a genus of plants belonging to the natural family Anacardiaceæ, consisting of shrubs or small trees, with small, inconspicuous flowers, disposed in racemes or panicles, and leaves usually pinnate. More than seventy species are known: all have a lactescent juice more or less acrid, and containing a gum-resin.—*R. coriaria* is found in the countries about the Mediterranean. The young branches, dried and powdered, were used by the ancients for tanning leather; and at present, in some parts of Italy, and especially Sicily, the leaves form an important commercial product on this account. The roots contain a brown, and the bark a yellow dye. The seeds are in common use at Aleppo at meals, to provoke an appetite. Both leaves and seeds are used in medicine, as astringent and styptic.—*R. typhina*, an American species, is a shrub 12 or 15 feet high. The young branches are thick, and covered with a dense coating of hairs; hence the common name of Stag's-horn Sumach. The leaves are pinnate and composed of numerous serrated

leaflets. The flowers are small and numerous, disposed in an upright hairy panicle, and are succeeded by small berries, which finally turn red, and render this shrub a conspicuous object in the American woods. It has been long cultivated in the European gardens for ornament. The berries possess the same properties as those of the preceding, and an abundant milky juice flows from the bark. This last is pulverized and employed for tanning.—*R. glabra*, another American species, is distinguished by the smoothness of the leaves and young shoots. The berries dye red, and the branches boiled with the berries afford a black, ink-like tincture. It is likewise cultivated for ornament in the European gardens, and possesses the same properties as the preceding.—*R. pumila* is a low, pubescent species, which is said to be the most poisonous of the genus.—*R. venenata*, commonly called Dog-wood or Poison Sumach, attains the height of 12 to 20 feet in the American swamps. The leaves are smooth and entire, the flowers greenish-white, disposed in loose panicles, and succeeded by whitish berries. The poisonous qualities of this plant are well known. Some persons are affected by touching or smelling any part of it, or even by coming within a certain distance, while others appear to be entirely exempt from its influence. When the poison has been communicated inflammation appears on the skin in large blotches in a day or two; soon after small pustules rise in the inflamed parts and fill with watery matter, attended with intolerable itching and burning, and lasting several days.—*R. copallina*, the dwarf sumach of America, is easily distinguished by the leafy expansion on each side of the common petiole. The flowers are greenish-yellow, and are disposed in panicles at the extremities of the branches.—*R. radicans*, often called Poison Ivy, is a climbing, woody vine, which adheres to the trunks and branches of trees by means of root-like suckers. The leaves are ternate, and the flowers are disposed in little axillary racemes. It affects certain individuals in the same manner as the poison sumach; but it seems to be less virulent, and fewer persons are exposed to its influence.—*R. aromatica* differs widely in habit from the others. It is a small straggling bush, with ternate leaves, having the flowers disposed in aments. The berries are hairy and red. The crushed leaves are sweet-scented. The celebrated Japan varnish is obtained from a species of *Rhus*, which was formerly considered identical with the Poison Sumach, but now is recognized as a distinct species, having the under surface of the leaves downy and velvety. This varnish oozes from the tree on its being wounded, and grows thick and black when exposed to the air. It is so transparent that when laid pure and unmixed upon boxes or furniture every vein of the wood may be clearly seen. With it the Japanese varnish over the posts of their doors and windows, their drawers, chests, boxes, fans, tea-cups, soup-dishes, and most articles of household furniture made of wood.

**SUMATRA**, a great island in the Indian Seas immediately under the equator. Its extreme limits are lat. 5° 45' N., and 5° 55' S.; lon. 90° 40' E., and 106° 5' E. In the direction of its greatest length it extends from north-west to south-east. Its greatest length is about 1000 miles, and its greatest breadth about 260 miles; its area is about 161,600 square miles. It ranks, therefore, in magnitude as the second of the Asiatic Islands, Borneo being the first. The west side of the island of Sumatra is mountainous, but the east side has a totally different character, and spreads out into interminable plains nearly as level as the sea. The mountains viewed from the west appear at first view to form a continuous ridge, but a closer examination reveals breaks in the chain,

and discloses the fact that two or three ridges lie behind that which is mainly seen from the coast. This chain, known generally as Barisan, extends from the north-west of the island to Sunda Strait. The islands of Pulo Bras and Pulo Wai really form detached parts of it, and near them, at the north-western end of the island, it attains a height of 5663 feet in Mt. Yamura. Farther south, but still in Achinese territory, are the lofty volcanoes Abong-Abong and Lúsé, whose heights are estimated at over 11,000 and 12,000 feet respectively. Mt. Ophir, close to the equator, is an extinct volcano 9610 feet above sea-level. Not far to the south is Mt. Merapi, one of the most violent of Sumatran volcanoes. Other notable peaks are: Talang (8343), an extinct volcano, from which the natives obtain sulphur; Indrapura (12,000), the highest peak yet ascended in Sumatra; Mt. Paung; Mt. Kaba (5413); Mt. Dempo (10,562), an active volcano; and Mt. Tangkarnus (7422), near the Straits of Sunda. Granite, slates, clay-schists, and similar rocks abound, and limestones of Carboniferous age occupy much of the surface. The tertiary formations cover a very large area. All the peaks seem to be volcanic. Various metals have been found in the island, and excellent coal is known to be abundant. The rivers that flow towards the west are naturally short and of small importance for navigation, but those traversing the broad alluvial eastern slopes are long and deep. Many of them form large deltas. In order from south to north the most important are: the Musi or Palembang, about 400 miles long, passing the town of Palembang and entering the sea opposite the island of Banka, an important highway for trade; the Jambi or Batang-Hari, over 500 miles long, and navigable throughout most of its length, important as an outlet for the chief coal-fields; the Indragiri; the Kampar; the Siak, rising near Mt. Ophir; the Rakan; and the Batu Bara. Of the west-coast rivers the Singkel is the most important. The lakes of Sumatra are mostly mountain lakes, and not a few of them occupy the craters of extinct volcanoes. The largest are: Toba, 500 square miles in area, at the source of the Singkel river; Singkara and Maninjau, about the centre of the island, near the west coast; Korinchi, near Indrapura; and Danau. Sumatra is almost bisected by the equator, and in consequence the monsoons of its northern extremity have different directions from those of the southern end. During the periods when the monsoon is changing, navigation in the neighbouring waters is impeded by squalls. The climate is generally of the usual tropical character, and is on the whole rather unhealthy. The flora of Sumatra differs much from that of Java. It is very rich in forest trees, many of which yield valuable timber or other useful products, such as dammar, benzoin, and gutta-percha. Its two species of *Rafflesia*, with their enormous flowers, and its giant aroid the *Amorphophallus titanum*, are notable plants. Pepper is the chief cultivated product. Sage and rice are also cultivated, and excellent tobacco and coffee are grown for export. The fauna of Sumatra in some respects resembles that of Borneo more closely than that of the countries with which it is almost in contact. The elephant and the tapir, frequent in Sumatra, are unknown in Java. The former island has the two-horned, the latter a single-horned rhinoceros. The orang-outang is found locally. The tiger occurs both in Sumatra and Java, but not in Borneo; Sumatra has also some species of deer and antelope, the sun-bear, a peculiar kind of hare, and the muntjac. The most notable birds are the Argus pheasant, several trogons, bush-shrikes, rain-birds, pheasant-cuckoos, &c. Of the domesticated animals

the most important by far is the pig, next to which rank the cow and the horse. The buffalo is more frequent in the low country, but is only valued as food, and never yoked for labour as in Java. The horse of the highlands is small, but vigorous and capable of enduring much fatigue. The authority of the Dutch now extends, nominally at least, over the greater part of the island, and may be considered to be real over all the coast districts. In the interior, however, there are still considerable tracts under native rulers, or forming village confederations, over which the Dutch exercise little or no authority. The Dutch possessions are divided into six chief divisions. The government of the West Coast, with an area calculated at 81,649 square miles, extends along the middle portion of the west coast, and includes Padang and other districts. The governor resides at Padang. The residency of Bencoolien lies to the south of that of the West Coast, and has an area of 9399 square miles, Bencoolien being the capital. The residency of Lampong comprises the southern districts of the island on the Strait of Sunda, and has an area of 11,284 square miles. The residency of Palembang on the east coast, with an area of 53,497 square miles, lies to the north of Lampong, and has as its capital the large town of Palembang. The district of Indragiri, farther north, belongs to the residency of Rhio, which is named after the island of that name. Farther north is the residency of the East Coast, its area being estimated at 35,312 square miles; and at the extreme north-west that of Acheen, which still remains semi-independent, area 20,471.

Sumatra is inhabited at the present day by a very mixed population. Malays collected from every quarter of the archipelago inhabit the coast. Hindus appear to have settled at an early age in the north, and to have modified the Malay type of the Acheenese. The Arabs in the island, though few in number, have always formed an important class. Chinese are numerous, particularly on the east coast. North-west of Palembang the Orang-Kubu live in a savage state, and shun any intercourse with the neighbouring tribes. The Orang-Kubu must not be confounded with the people of Menangkabu, a pure Malay race inhabiting the highlands of Padang, which some are disposed to consider the original seat of the Malay stock. The Battaks are a peculiar and interesting race. Like the Malays they are of short stature, but they differ from the former in being strongly built and well proportioned. The art of writing has been known among the Battaks from a date beyond the reach of tradition. Their characters are peculiar, and also their mode of writing, for they begin at the bottom of the page at the left-hand side, and place letter above letter in a vertical column till they reach the top, when they return to the bottom. Their ancient books are written in a brilliant ink on paper made of the bark of trees, but now they scratch their writings on slips of flattened bamboo. Their moral character is very favourably spoken of by travellers. The chief blot upon it is their addiction to cannibalism. Among all the indigenous tribes of Sumatra the characteristic political tendency is one that could have originated only in the recesses of the mountains. Every village affects independence, but the villages form confederations. The native tribes of Sumatra have no temples and no priests. They are said to believe in the existence of an evil spirit and of demons who haunt the mountains. On the coasts Buddhism appears to have been introduced at an early age, but it has since been completely superseded by Mohammedanism, which, among the Malays, however, is of a very relaxed character. Pop. in 1897, 3,209,037.

The first European who visited the island of Sumatra is said to have been Niccolo di Conti, who came there before 1449. In the beginning of the sixteenth century it was visited by the Portuguese, but no Europeans obtained a firm footing on the island until the Dutch established a factory on the west coast at the end of the sixteenth century. In 1666 the Dutch took possession of Padang, and soon after enlarged their territories by treaty with the Sultan of Acheen. Since that time they have gone on continually consolidating and increasing their dominion much more by negotiation than by force of arms. Their last important accession of influence on the island was gained by a treaty with the Kingdom of Siak, concluded in 1686, by which they obtained the virtual control of that state. In 1685 the British formed a settlement in Bencoolen, and in 1811 they seized the Dutch possessions on the island. These were, however, restored in 1815, and in 1824 Bencoolen was given over to the Dutch in exchange for Malacca. A treaty concluded between the Dutch and English governments in 1834 left the Dutch free to make what treaties they pleased with the native powers in the island of Sumatra, the same liberty being allowed to the British on the Malay Peninsula; but the right of the Dutch to make advances in the island by conquest and annexation was not then recognized. This right was, however, conceded in the treaty of February, 1871, in return for the cession to the British of the Dutch possessions on the Gold Coast; and in accordance with this permission the Dutch despatched an expedition against Acheen. In April, 1873, the forces of the two powers came into collision, and a war ensued which dragged on for a number of years, caused severe losses to the Dutch, and after all has terminated only in the nominal subjugation of Acheen. In August, 1883, the tidal wave that accompanied the terrific volcanic outburst in Krakatoa, swept with destructive effect the south coast of Sumatra, a total change in the aspect of the Straits of Sunda also resulting from the eruption.

**SUMBAWA** (Dutch, *Soembawa*), an island in the Indian Archipelago, belonging to the Sunda group, bounded north by the Java Sea; south by the Indian Ocean; west by the Strait of Allas, separating it from the island of Lombok; and east by the Strait of Sappi, separating it from the island of Comodo. It is about 160 miles long from east to west, with a breadth varying from 13 to 31 miles. It is divided into two native states, reigned over by sultans, both of whom acknowledge subjection to the Dutch. The soil is not generally fertile, and water is apt to be scarce, especially in summer. Some parts, however, do not suffer in this way, and are watered by permanent streams. Sappan-wood and rice are the chief products beyond the usual tropical fruits. Deer and swine are plentiful, but cattle, goats, and fowls are not abundant. Horses, the finest in the Indian Archipelago, are extensively bred and exported. Fish are plentiful, and edible birds'-nests are procured on the coasts. Gold, sulphur, saltpetre, and pearls are obtained. Sumbawa is mountainous, and its heights have such a remarkable appearance, that once seen they are never forgotten, a fact which renders them an excellent landmark for ships passing to and from China. Near the northern coast is the noted volcano of Tomboro or Tombura, 8940 feet high, of which a dreadful eruption took place in April, 1815, the noise of which was heard in Celebes, the Moluccas, and Sumatra, or over an area with a radius of above 840 miles. Another eruption occurred in November and December, 1836, but much less destructive in its effects. The town of Sumbawa on the north coast, in a bay looking to the north, has a good harbour. Pop. estimated at 150,000.

**SUMMER**, in Great Britain, the season comprehended in the months of June, July, and August. The astronomical summer lasts in the northern hemisphere from the June solstice to the September equinox, while the sun is in the signs of Cancer, Leo, Virgo; and, in the southern, from the December solstice to the March equinox, while the sun is in Capricorn, Aquarius, Pisces. Our summer takes place at the time when the earth is at the greatest distance from the sun, and hence moves the slowest. The diameter of the sun, therefore, appears considerably smaller at this season than in winter, and the summer of the northern hemisphere has ninety-three and a half days—a few days more than the winter—and, therefore, more than the summer of the southern hemisphere. Notwithstanding the greater distance of the sun in summer, his rays have much more effect than in winter, because they fall more directly upon the northern hemisphere. He also rises much sooner, and sets much later, and therefore describes a much greater arc in the heavens than in winter. At the time when he has reached the tropic of Cancer he ascends highest in the heavens, and remains longest above the horizon; and we might, therefore, suppose that this would be the period of the greatest heat. But experience shows that the greatest heat generally takes place in August, throughout the whole northern hemisphere, far beyond the polar circle. The reason of this circumstance is, that, in August, the influence of the sun's rays has been felt for a long time on the earth, and that, within the polar circle, as far as to the tenth or twelfth degree from the pole, the ice has been thawed and the temperature of the air moderated; hence the wind which blows from those northern regions to the south is milder. See **SEASONS**.

**SUMMER-DUCK** (*Aix Sponsa*), a species of Anatinae or true Ducks, allied to the Mandarin Duck or Chinese Teal (*Aix galericulata*) (see **TEAL**), and distinguished as a genus by the bill being shorter than the head, by the horny tip of the bill being very large, and the edges of the bill straight. The wings have their second quill-feathers longest, and the toes are provided with a very large thick web or membrane, the hinder toe being unconnected to the other digits by the web. These birds inhabit North America. Their range of distribution extends in summer pretty far north on that continent, and they are then, and at the breeding-time, found in Nova Scotia. In winter the southward migration brings hosts of these ducks to Mexico, Texas, and other southern parts. These ducks may be more or less completely domesticated. Like the Chinese Teal, the Summer-duck may perch upon trees, the nest being found usually in the hollows and trunks of trees.

**SUMMONS**, an admonition to appear in court, addressed to the defendant in a personal action. It is the writ by which a personal action is always commenced. According to English law it need not state the form or cause of action, but it must contain the names of all the defendants, and must have indorsed upon it the name and address of the person taking it out, whether the plaintiff himself or his attorney. It must also bear the date of its issue, and when issued against any person residing in England, Scotland, or Ireland, it is in force for six months after that date. It is the duty of the person taking out a summons to serve it on the defendant in person; but if the judge is satisfied that reasonable efforts have been made to do this, and that the defendant knows that the summons has been issued against him, he may authorize the plaintiff to go on with the action without personal service. When the person against whom a summons is issued is a British subject residing abroad, the form of the summons is modified, and the time within which the defendant

is required to appear in court is regulated according to the distance of his domicile from England. A special form of summons is also used in the case of foreigners residing abroad.

The law of Scotland requires a summons not only to contain the authority by which it is issued, and the name of the person against whom it is directed (the defender), but also to set forth the grounds and conclusions of the action. When it arises in the Court of Session it is issued in the sovereign's name, and is signed by a writer to the signet; but in an inferior court it is issued in the name of the inferior judge or magistrate presiding over that court. Two or more persons not having a joint interest in the circumstance on which an action is grounded, but having separate claims against the same or different persons, cannot take out a single summons against such person or persons; but if they wish to escape the expense of separate actions, must intrust their claims to one of their number or to a third party. Any number of persons may be included under one summons as defenders, when they are all liable under the same ground of action, but when their interests are different no more than six can be so included.

SUMNER, CHARLES, an American jurist and statesman, born at Boston, Massachusetts, January 6, 1811; died at Washington, March 11, 1874. Having completed his general education at Harvard University he applied himself to the law, and in 1834 was called to the bar. Soon after he was appointed reporter of the United States Circuit Court, and in 1836 he published three volumes of Judge Story's decisions. These afterwards became known as Sumner's Reports. During the same period he lectured as a substitute for the professor before the law school in connection with Harvard University, and edited a periodical called the *American Jurist*. In 1837 he started on a visit to Europe, and he spent about three years in travelling over England, Germany, France, and Italy, extending his knowledge in all directions. After his return to Boston in 1840 he resumed his legal practice, and between 1844 and 1846 he published, in twenty volumes, a carefully edited and annotated edition of Vesey's Reports. About this time he began to show his political bent. He made several speeches at political meetings, manifesting from the first the deep-rooted anti-slavery sentiments that formed, until his object was attained, the dominant principle of his political action. In 1851 he was elected to the Senate of the United States, and thenceforward, both in the Senate chamber and out of it, he took every opportunity of advocating the cause that he had chiefly at heart. In May, 1850, after the delivery of a speech in the Senate on slavery in Kansas, in which he had attacked the slave-holders with uncompromising severity, he was personally assaulted by Preston S. Brooks, an enraged member, representing one of the slaveholding states. The injuries he received were so severe that he was obliged to withdraw from public duties for nearly four years, most of which time he spent in Europe. In the spring of 1860 he again took his seat in the Senate, and in the summer of that year laboured actively in support of Lincoln and Hamlin as candidates for the presidency and vice-presidency of the United States. In the summer of 1861 he became chairman of the Senate committee on foreign relations, and this post he continued to hold for ten years. He was a decided enemy to the policy of President Johnson, the successor of Lincoln, and was active in his impeachment trial. He voted for President Grant, but subsequently became the most determined opponent both of his home and foreign policy; and in 1872 he was a zealous supporter of the candidature of Horace

Greeley, although the state of his health forbade him to take an active part in the election campaign. After the re-election of Grant he seldom appeared again in debate. A collection of Sumner's speeches was published in 1850, and another containing more recent speeches in 1856; and an edition of his complete works, embracing numerous pamphlets of passing interest, was published between 1870 and 1879 (15 vols.). See the *Memoirs and Letters of Charles Sumner*, by E. L. Pierce (4 vols., 1877-98).

SUMPTUARY LAWS, such as are intended to repress extravagance, especially in eating and drinking, and in dress. They are altogether foreign to the spirit of modern legislation, being regarded as tyrannical and absurd, as well as contrary to the most elementary principles of political economy, and, it may be added, contrary to the principles of human nature, as is proved by the utter inefficacy of such laws wherever and whenever passed. In ancient times, however, they were common, and the statute-books of most modern nations also have borne such laws upon them from an early date, and in some cases down to a comparatively recent period. Sumptuary laws were much more frequently enacted in ancient Rome than in Greece. And the reason is not difficult to find. Luxury did not penetrate into Greece till after the fall of liberty. Yet a few instances are found even in Greece of regulations of this nature. At Athens, for example, the ten *sophronistai*, whose main duty it was to watch over the manners of the young in the gymnasia, were also required to see that the number of persons present at festivals did not exceed that allowed by the law. A sumptuary law of the Locrian lawgiver Zaleucus (seventh century B.C.) has also come down to us. One of the laws of the Twelve Tables aimed at repressing extravagance in funerals. After the establishment of the censorship those holding this office had the right of punishing those guilty of luxurious living, by affixing the *nota censoria* to their names. After the Twelve Tables the first sumptuary law passed at Rome was the *Lex Oppia* (215 B.C.), directed exclusively against the extravagance of women in dress, jewelry, &c. This law was repealed twenty years later. The other sumptuary laws enacted at Rome were almost exclusively designed to keep down extravagance in entertainments. The principal were the *Lex Orchia*, passed in 181 B.C.; *Lex Fannia* (161 B.C.); *Lex Didia* (143 B.C.); *Lex Licinia* (about 103 B.C.); *Lex Cornelia*, passed in 81 B.C., and due to the dictator Sulla, who conceived the happy thought of ridding the market of delicacies by fixing a tariff for them below the ordinary selling price; *Lex Æmilia* (78 B.C.); *Lex Antia*, of uncertain date; and *Lex Julia*, passed in the reign of Augustus. This was the last sumptuary law passed at Rome, but a few endeavours were made under later emperors also to repress luxury by decrees of the senate and imperial edicts. The last attempt of this nature that is known to have been made belongs to the reign of Nero. Sumptuary laws were revived by Charlemagne. Both he and Louis the Débonnaire promulgated capitularies against luxury in dress and furniture. Various other laws and decrees having a like object were made under many of the later kings of France, even down to Louis XV. A royal ordinance, dated April 19, 1737, forbids the common people (*vilains*) the use of calico, which was reserved for the use of the nobility, and there are instances of the wives of commoners being fined in virtue of this decree. In England sumptuary laws began to be enacted in the reign of Edward III., and continued to be passed down to the time of the Reformation. Most of them were repealed by 1 James I. cap. xxv., but they were not all expunged from the statute-book till

1856. Various laws were passed by the ancient Scottish legislature with the same object, but they had the same fate as such laws passed elsewhere; they were soon repealed, evaded, or neglected. There is at least one value which sumptuary laws have. They furnish historians of the present day with almost the only documentary evidence of the degree in which various comforts and luxuries were enjoyed by different nations in past ages, and more especially with a great deal of minute information regarding the private life of the Greeks and Romans.

SUMY, a town in Russia, in the government of Kharkov, on the right bank of the Psol, 83 miles north-west of the town of Kharkov. It lies in a fertile district, has numerous distilleries, a trade in brandy, corn, and other agricultural produce, and four large annual fairs which attract great numbers of dealers from distant parts. Pop. (1897), 26,622.

SUN, the central orb of the solar system. The sun's diameter is 852,900 miles; its mean density is about  $\frac{1}{4}$ , taking that of the earth as 1; its mean distance from the earth is taken as 92,900,000 miles. The axis of the sun's rotation is inclined to the ecliptic at an angle of  $82^{\circ} 40'$ , and its rotation period (see below) is variously estimated at from twenty-five to twenty-eight days. In the beginning of June and in the beginning of December the sun's equator would appear a straight line to an observer from the earth; early in September its equator appears a semi-ellipse convex southwards, and early in March a semi-ellipse convex northwards, the curvature being a maximum in September and in March. If the sun differs from a perfect sphere, this difference cannot be detected.

Mathematically considered there is no difficulty in accounting for the motions of the planets round the sun. It was from a consideration of Kepler's laws, deduced from the observations of Tycho Brahe, that Newton mathematically discovered the nature of gravitation. The mass of the sun is about 750 times that of all the other members of the solar system taken together, and the centre of gravity of the solar system lies somewhere in the sun, whatever may be the relative positions of the planets in their orbits. The popular notion that the natural state of matter is a state of rest is a wrong notion. Every portion of matter having a temperature above absolute zero possesses energy, and is probably the theatre of continual motion among its molecules, and, besides, it has at any instant a velocity in some direction in the universe. It is on account of the false notion we refer to that there is with most people a difficulty in understanding why the planets describe orbits round the sun instead of rushing direct to the sun from the action of gravitation. The simple action of a central force, shown in the revolution of a planet round the sun, does not take place in any machine we can invent, but we shall try to illustrate it by two examples:—Set up a piece of steel-wire in a vice so that it may be firmly fixed at one end, while the other is free to vibrate. One blow will make the point of the wire vibrate in a straight line (looked at from above), and a second blow in a direction at right angles to that of the first, given when the point is at the end of its path, will cause the point to describe a circle or ellipse. At any point of the path there is the force of the spring drawing the wire to the central position, yet the orbit of the wire point is a circle or ellipse. At the instant when the wire received the second blow there was no force acting on it except the central force, and just at its returning point it was at rest. The second blow imparted a store of energy, which, if there were no resistance of the air, and if the spring were perfectly elastic, would not diminish, and the wire

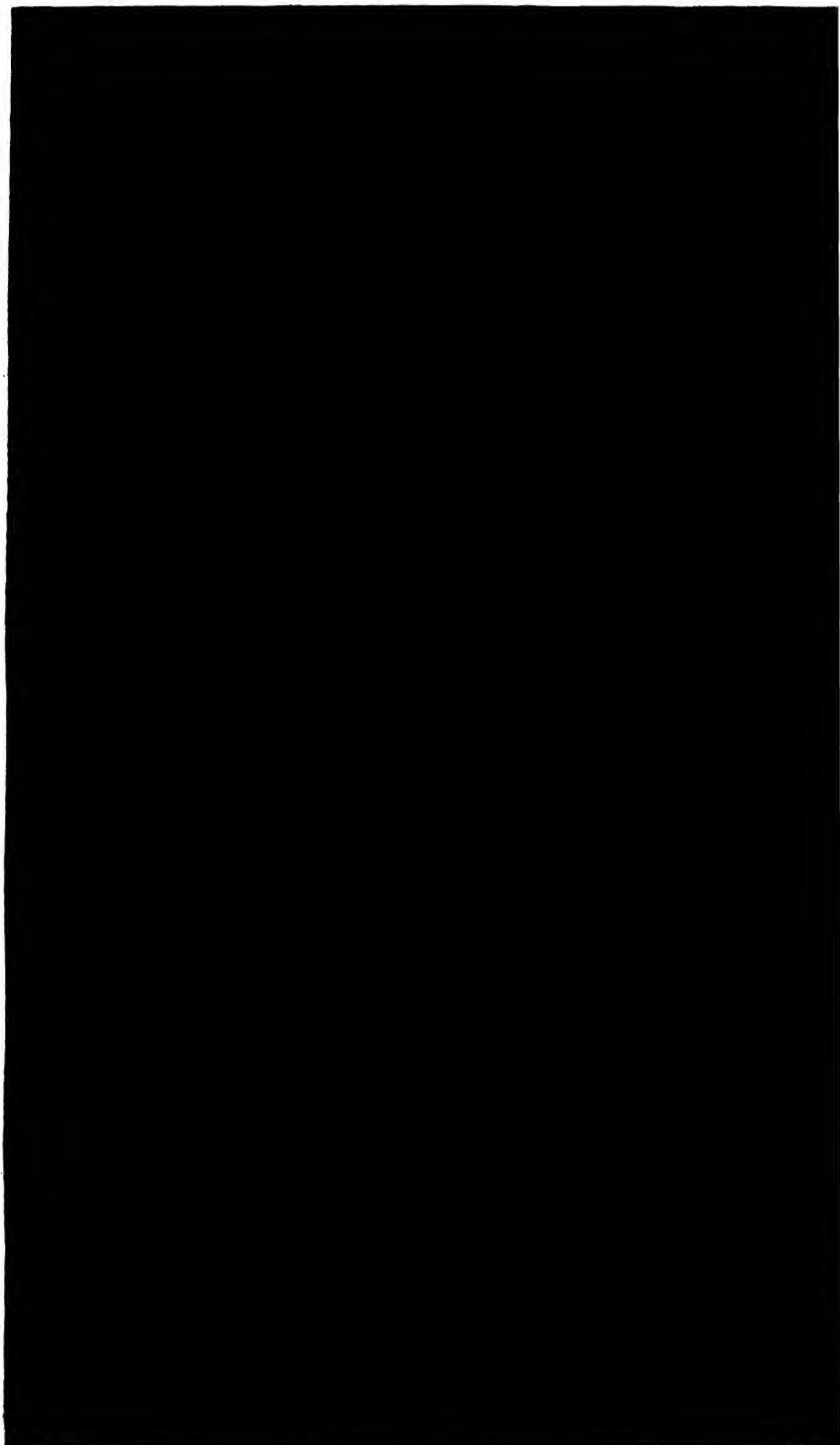
would continue its curvilinear motion for ever. The attraction of gravitation differs from the force of such a spring, inasmuch as the force of gravity is inversely proportional to the square of the distance, while that of the spring is proportional to the distance; but, keeping this difference in mind, we can think of our first blow as representing the energy of position due to a planet's distance from the sun, and of the second blow as representing the energy of the planet's tangential velocity. Again, if a bullet of lead suspended by a fine thread in *vacuo* be made to describe a circle, the motion will continue for a long time undiminished, and, neglecting the slight friction at the point of suspension, the only force acting on the body is the force tending to make the bullet hang plumb. The weight of the bullet being compounded with the stress in the inextensible thread, gives a resultant force drawing the bullet to the centre of its orbit. In this case also the central force decreases as the orbit is smaller, but the force drawing earth and sun together would increase if the orbit became smaller. If straight lines are drawn from the centre of a circle in all directions it will be seen that they all cut the circumference at right angles, so that a body describing a circular orbit under a central force has its motion always in a direction at right angles to the direction of the force, and its velocity is not increased by the action of the force (the tendency of the body's initial velocity is to make the path form an acute angle with the central force, and it is this tendency which is balanced by the force), but straight lines drawn from a focus to the circumference of an ellipse cut the circumference at right angles only in two points. If we consider the elliptic orbit of the earth these points are perihelion and aphelion. When the earth has passed aphelion the direction of the central force is such as to increase the earth's velocity, and after perihelion the force retards the velocity.

From the time when Galileo's telescope first made visible dark patches or spots on the sun these spots have been objects of great interest. Galileo supposed them to be clouds. They are of various sizes, some very small, while others have a diameter of nearly 100,000 miles. They are generally in groups, and, like the clouds of our atmosphere, they are continually changing their forms and dimensions. They always present a black or very dark central portion and a lighter surrounding fringe; the former is called the nucleus or umbra, the latter the penumbra. These spots have been shown to be hollows in the luminous surface of the sun (photosphere), and their depth has been estimated at from 3000 to 10,000 miles. Spots are called also macule; brighter portions of the sun are called facule; the lesser markings are called mottlings. Spots are more numerous and larger at some times than others, being at a maximum once in about 11.1 years. Recently it has been stated that the average annual rainfall is greater in a degree corresponding to the increase in the number of the sun-spots. Spots are most numerous between the latitudes  $30^{\circ}$  and  $35^{\circ}$  north and south, and never occur higher than  $50^{\circ}$ . The late Mr. Carrington gave a formula which represents the distance, in angular minutes, moved through by a spot in any latitude during twenty-four hours mean solar time: it is  $865 - 165 \sin^2 l$ , where  $l$  is the latitude. At the equator  $\sin l = 0$ , and therefore the period of a spot at the equator is given by  $\frac{860 \times 60}{865}$ , that is,

25 days nearly. Again,  $\sin 30^{\circ} = \frac{1}{2}$ , and  $\sin^2 30^{\circ} = \frac{1}{4}$  nearly; so that the formula for latitude  $30^{\circ}$  becomes  $865 - 165 \times \frac{1}{4}$ , and the period is therefore  $\frac{860 \times 60}{865 - 40.5}$



THE SUN.



1. PROTUBERANCES, AS OBSERVED BY TROUVELOT 15<sup>TH</sup> APRIL, 1872.



Printed from the Originals by the Bibliographisches Institut Leipzig.



= 26.45 days nearly. As the attempts to settle the period of rotation of the sun are all by means of observations of sun-spots, discordant results are obtained by different observers. It is seen from the formula that a spot near the equator travels faster than one at a higher latitude, and it is supposed that the photosphere has a velocity greater than that of the nucleus.

As to the constitution of the sun, and the cause and nature of the spots, opinion is still much divided. The small specific gravity of the whole mass, however, is greatly in favour of what is at present the prevailing doctrine, namely, that the sun is mainly gaseous, but covered by a sort of luminous shell of cloud formed by the precipitation of the vapours which are cooled by external radiation. According to this view—that of M. Faye, a French astronomer—the central core of the sun is only feebly luminous, because finely gaseous, while the dazzling surface, or *photosphere* as it is called, owes its brilliance to the minute liquid incandescent particles which result from condensation. The spots are supposed to be cavities in this cloud-layer, which, according to Faye, are caused like eddies in a river, by the unequal velocities of neighbouring portions of the photosphere, resulting from the peculiar law of the sun's rotation already stated. These eddies Faye supposes would form funnel-shaped hollows, into which the cooler overlying atmosphere would settle, and by its absorption produce the observed darkening. According to this view, of course, the spots ought to be nearly round, and to exhibit a marked gyratory movement, but this is seldom the case. Secchi maintained that they were openings formed by explosions from below. Zöllner, who considers the body of the sun to be liquid, sees in them slags or scoriae floating on a molten surface. Sir J. Norman Lockyer has attempted to explain sun-spots as produced by a system of solar atmospheric circulation.

The amount of heat radiated by the sun per minute admits of pretty accurate measurement, and was determined many years ago by Pouillet and Sir J. Herschel, whose results have since been verified and slightly corrected. It is found that the sun's radiation would melt a shell of ice covering its own surface to a depth of between 39 and 40 feet in one minute. The temperature and amount of radiation have not materially changed for the last 2000 years, as evidenced by terrestrial climatology. According to Faye the expenditure of heat is supplied by the passing of portions of its mass from the gaseous state into the liquid or solid.

The photosphere is overlaid by an atmosphere containing in its lower regions nearly all the materials which enter into the composition of the sun, while higher up the lighter gases alone prevail. This atmosphere is of course invisible under ordinary circumstances, but reveals itself to the spectroscope. As every one knows, the spectrum of sunlight is a continuous band of colour crossed by numerous black lines, which are especially crowded and intense in the indigo and violet. The cause of these lines remained a mystery until in 1859 Kirchhoff explained it by showing that they are due to the filtration, so to speak, of the light from the photosphere through an atmosphere containing metallic vapours. He showed that while such a vapour by itself would give a characteristic spectrum of bright lines, this spectrum would be *reversed*, and show itself as a spectrum of black lines whenever a light of sufficient intensity was made to traverse the vapour from behind. Other investigators have continued the work begun by Kirchhoff, and the existence of many terrestrial elements in the sun has been established. According to the results of Prof. Rowland

of Johns Hopkins University, the presence of two non-metals, carbon and silicon, and of some thirty-four metals, notably iron, barium, titanium, calcium, hydrogen, nickel, cobalt, chromium, sodium, magnesium, silver, tin, and vanadium, is certain. Oxygen has not yet been detected in the sun.

In 1706 Captain Stannyan, during a total eclipse of the sun, observed that just before the limb of the sun appeared after totality there was a blood-red streak. Such appearances were subsequently noticed, but it was not till 1842 that they were first scientifically described under the names 'flames,' 'protuberances,' or 'prominences.' After their nature had been for some time discussed the spectroscope was applied to them in 1868, and it was shown that these appearances are due mostly to enormous masses of glowing hydrogen gas, floating above the sun in some upper atmosphere as the clouds do in ours. Shortly afterwards it was discovered that these phenomena could be observed by means of the spectroscope without an eclipse. Suppose light from two bodies co-existing, the light from one giving a continuous spectrum (light from the photosphere), that from the other giving a spectrum of bright lines (light from the red flames). With an ordinary spectroscope the continuous spectrum will mask the spectrum of the gas; but by adding prisms so as to increase dispersion, the continuous spectrum may be so much spread out that the bright-line spectrum will become visible. This is the principle of the discovery made independently by M. Janssen and Mr. Lockyer. An instrument called a telespectroscope is constructed of the object-glass and tube of a direct-vision telescope and a spectroscope whose slit is capable of adjustment in the principal focus of the object-glass. The spectroscope is formed with a collimator and telescope, and, to obtain great dispersion, six or seven prisms are employed, arranged in a circle. It will be remembered that a spectrum is built up of images of the slit, and that when the spectrum consists of a few bright lines these images are not injured by overlapping. In the telespectroscope the image of a prominence falls exactly on the slit, and consequently, with the slit wide enough to receive all of the prominence, the contour of the prominence is seen as well as its spectrum. The region outside the photosphere in which these coloured prominences are observed, or from which they rise, has been called the *chromosphere*. The bright-line spectrum of the prominences can be observed, as detailed above, at the limb only. The presence of a great number of substances in the chromosphere in a state of gas is indicated by the dark lines of the solar spectrum, and many of these substances are the same as substances we have on the earth. The chromosphere is found to have an average depth of from 8000 to 8000 miles. The coloured prominences ascend to a great height above this, and the incandescent hydrogen spreads out into immense clouds of forms as beautiful, varied, and changeable as those to which we are accustomed in our terrestrial sky. These cloud-forms reach altitudes of 20,000 to 100,000 miles with a horizontal extent twice as great. Jets of the chromospheric hydrogen have also been observed to reach a height of 200,000 miles in twenty minutes, and disappear altogether within half an hour. Outside the chromosphere, extending very far out from the sun, is the *corona*, an aurora of light observed during total eclipses, and which is now the chief object to be observed by eclipse expeditions. Its appearance has been compared to the 'glory' with which the old painters encircled the heads of saints. This phenomenon has been shown to be connected with the existence of what is called the 'coronal atmosphere,' but the nature of this atmosphere is as yet undetermined.

Extending our suppositions, and applying them to stars which we may think of as distant suns, we may imagine a photosphere subject to breaches from above (sun-spots), whose colour depends on the substance composing it; that outside this there is a chromosphere, the gaseous elements composing it indicated by dark lines in the spectrum, and extending far beyond the gaseous envelopes there is circulating planetary or meteoric matter giving rise to a corona. We have stars which vary as if there was a struggle to form a permanent photosphere only periodically successful, and we have stars varying in colour as if the photosphere varied as to its substance.

**SUN, WORSHIP OF THE.** It is a prevailing theory at the present day that the sun was the chief object of worship in the earliest times among all nations, and that in all mythologies he is the principal hero. (See MYTHOLOGY.) The chief deities of the polytheisms of ancient India, Egypt, Greece, Rome, Germany (Indra, Amoun Ra, Zeus, Jupiter, Odin, &c.), are all identified as sun gods, but in all these cases the sun has been personified and endowed with attributes not all derived from his original nature. But among some peoples the sun itself, as a physical object, long continued to have worship paid to it, and this worship was generally associated with that of fire, as among the followers of Zoroaster, the ancient Celts, &c. The most complete system of sun worship seems to have been that of Peru. See BELZEIN, GUEBERS, PERU—Religion.

**SUNART, LOCH,** an inlet in Scotland, in the west of Argyleshire, between the districts of Ardnamurchan and Sunart on the north, and that of Morven on the south. It opens into the Sound of Mull. It is about 20 miles long, and varies in breadth from less than  $\frac{1}{2}$  mile to 3 miles.

**SUN-BIRD,** the name given to a large group (Promeropidae) of Tenuirostral Insectores, allied to the Humming-birds, and possessing as a family an elongated, slender, and curved bill, with the nostrils covered by a scale placed at its base, the wings of moderate size, and the tarsi short and covered with broad scales. The true Sun-birds, forming the distinctive group, are included in a special sub-family, that of the Promeropinae. The central tail-feathers in these forms are prolonged beyond the others; the bill is keeled, and the edges of the lower jaw may be finely notched or serrated; the third and fourth quills or the fourth only of the wings are longest; the outer toe is longer than the inner, and the nostrils are situated in a broad groove. These birds are confined to the tropical regions of the Old World, and occur in the islands of the Eastern Archipelago, in India, and Africa. They take the place of the Humming-birds of the New World, and in brilliant coloration and habits much resemble these. They are constantly hovering about amid flowers, and appear to subsist on the minute insects found within the petals; whilst they are also believed to sip the flower-juices, and from this latter belief the name of Sucrifiers, or Sugar-eaters, has been given to these birds by French authors. Some certainly eat fruits, Layard observing that a Ceylonese species ate the berries of a mistletoe-like plant. The song is sweet, but without any special characteristics, and in habits they are exceedingly lively, quarrelsome, and even pugnacious. The brilliant colours (as in the Humming-birds) are chiefly confined to the male Sun-birds. The nests are built in the hollows of trees, or are placed in thick bushes. Some species (such as *Nectarinia Lotenia* and *N. Asiatica*) make dome-like nests, which are suspended from the extremities of twigs or bushes, and are covered with cobwebs for the purpose of concealment. Spiders often weave their webs around the structure, and thus bring the

aid of nature to that of the art of the bird. The nests are built of vegetable fibres delicately interwoven, the interior of the nest being lined by soft cottony materials also derived from plants. The entrance is generally made to face the interior of the bush, and the whole structure may be sheltered from the rain and sun by a shelving ledge projecting over the roof of the nest. The eggs are generally white or gray in colour, and number from two to four. The males at the breeding-season display their most brilliant plumage, and become adorned, doubtless with the aim of 'selecting' the females. See NATURAL SELECTION.

**SUNDA ISLANDS,** a group of islands in the Indian Archipelago; composed of the Great Sunda Islands, namely, Sumatra, Borneo, Celebes, Java, Madura, Banka, and Billiton; and of the Lesser Sunda Islands, namely, Bali, Lombok, Sumbawa, Flores, Tjendian or Sumba, Sabrao, Solor, Lomblem, Ombai, and the Timor group.

**SUNDAY.** See SABBATH.

**SUNDAY-LETTER.** See DOMINICAL LETTER.

**SUNDAY-SCHOOLS.** Very early in the history of the Christian church, indeed almost from its commencement, it seems to have been the practice to give instruction on the first day of the week to those who were being prepared for admission into the church. This practice was continued, at least as late as the eighth century, but was ultimately given up. In 1527 several Sunday-schools were established by Martin Luther in Germany for the instruction of children and youths who could not attend the day-schools, in the art of reading, that they might thereby be better able to read the Holy Scriptures. In the latter half of the same century Cardinal Borromeo organized Sunday-schools in the cathedral of Milan, and eventually throughout his diocese. But there was no extensive movement in favour of Sunday-schools until such a movement originated in England towards the close of the eighteenth century. The founder of the modern Sunday-schools was Robert Raikes, editor of the Gloucester Journal. Struck with the wretched appearance of a number of children whom he saw playing in the street in the suburbs, he was informed by an inhabitant to whom he addressed himself, that on Sundays, when they were released from work, and the few who enjoyed the benefit of any instruction during the week were let loose from school, they presented a more afflicting sight of misery and vice. This observation immediately suggested to him the idea that the profanation of the day might be prevented by putting them to school; and he engaged several women, who kept schools in the neighbourhood, to receive such children as he should send to them on Sundays, and instruct them in reading and the catechism, paying each of them a shilling for her day's work. He soon collected a considerable number of children, distributed books among them, gave them advice, settled their quarrels; and the effects of his benevolent exertions were so striking, that his example was followed by other charitable persons in different quarters of the city, and in a few years Sunday-schools were established in almost every part of Britain. Raikes made his first experiment in 1781, and in 1786 it was estimated that 250,000 children were receiving instruction in Sunday-schools. (See Gentleman's Magazine, vol. liv. page 410, 1784.) A Sunday-school society was formed in 1785 for the encouragement of Sunday-schools by pecuniary aid, &c., the schools having been at first taught by hired teachers. Gratuitous instruction was a great improvement in the system, and appears to have become general about 1800. In 1803 the first Sunday-school union was formed in London, and the example was soon imitated in

many large towns and some of the counties. The Scotch Sabbath-schools (first established in Edinburgh in 1787) arose from the English Sunday-schools, but from the first were more entirely devoted to religious instruction than the Sunday-schools of England, there being less necessity in Scotland for teaching the children to read. So universal has the institution of Sunday-schools now become in the British Isles that there is scarcely a church in connection with which one does not exist, taught for the most part gratuitously by members of the congregation. Since 1848 numerous mission Sunday-schools have been established for the instruction of neglected children in poor districts. They are supported by particular churches, Young Men's Christian Associations, or by city missionary or Sunday-school societies. The number of children attending the Sunday-schools of the United Kingdom has been estimated at about 6,700,000. In America the first Sunday-schools were opened at New York in 1816, and they have since multiplied rapidly and overspread the whole country. By the year 1815 they had been introduced into most of the countries of Europe, but they flourish best in English-speaking countries.

**SUNDERBUNDS.** See GANGES.

**SUNDERLAND**, a market-town, seaport, municipal, parliamentary, and county borough in England, in the county of Durham (of which it is the largest town), at the mouth of the Wear, 13 miles north-east from Durham and 12 miles south-east from Newcastle, connected with these towns and with Hartlepool by branches of the North-Eastern Railway. Connected with the railway accommodation there are a high-level bridge over the river, a cutting through the town, a tunnel under the parks, and a central station. Excepting a net-work of narrow insalubrious lanes in the old portion, many of which have been widened, the town is well-built and healthy. The new parish of Sunderland, conterminous with the borough, includes the old parishes of Sunderland, Bishopwearmouth, Bishopwearmouth Pans, Monkwearmouth, and Monkwearmouth Shore, the latter two on the north bank of the river. The ancient parish church of Monkwearmouth (restored) stands on the site of the monastery founded at the mouth of the Wear by Benedict Biscop in the seventh century, the monastery in which the Venerable Bede was educated. The tower of the church and part of the adjoining walls are supposed to be relics of the original structure. The best shops and business places are in High Street, the main thoroughfare through Sunderland proper from east to west, and in the intersecting thoroughfare from north to south of Bridge and Fawcett Streets. Belonging to the rate-payers are the parks of 61½ acres, museum, art-gallery, free library, school of art, bath and wash-house establishments, board schools, cemeteries, municipal technical college, electric tramway system, &c. The public buildings include churches and chapels, theatres, music-hall, Victoria Hall, Central Hall, Workmen's Hall at Monkwearmouth, Pottery Buildings Hall, and a fine Town Hall, in the Renaissance style, having a grand tower at the principal entrance. The institutions comprise a literary society with library, philharmonic society, Young Men's Christian Association, government science classes, &c. There are three handsome clubs (two of them political), infirmary and general hospital, eye-infirmary, almshouses, hospitals for sick children and foreign seamen. The river is crossed by a cast-iron bridge, built in 1793 by Rowland Burdon, an ingenious country gentleman, the arch (236 feet span and 108 feet above low-water mark) being formed by cast-iron blocks fitted together; the bridge was recon-

structed and strengthened by Robert Stephenson. An iron railway-bridge lies alongside of it. The harbour and river entrance is formed by two piers, with lighthouses; two other great piers, to form a sort of harbour of refuge, are partly constructed. On the south side of the river are the chief docks, with a direct sea entrance as well as an entrance from the river. The total water area of docks and basins is over 78 acres. North of the harbour are the bathing-place of Roker with its cavernous limestone cliffs, the village of Whitburn, the electric lighthouse at Souter Point, and the curious marine grotto of Marsden Rock. The staple trade interests of the place are shipping, the coal trade, and ship-building. In 1900 the number of vessels that entered the port of Sunderland was 6377, of 2,453,883 tons; the number cleared 6487, of 2,559,025 tons. The number of vessels belonging to the port was 252, of 266,211 tons. Coal is the chief export. The ship-building yards in 1900 turned out 54 vessels of 122,580 tons, besides 12 vessels of 25,106 tons built for foreigners. There are large works for the making of marine engines, iron-works, works for anchors and chain cables, forges, works for glass bottles, sheet and plate glass, earthenware, ropes, besides numerous minor industries. The imports are chiefly timber and grain, with various raw materials and provisions from the Baltic ports and Holland. There is a considerable fish trade. The municipal borough is governed by a mayor, sixteen aldermen, and forty-eight councillors. Its population in 1881 was 116,542; in 1891, 130,921; in 1901, 146,565. The parl. bor. returns two members; pop. in 1891, 142,248; in 1901, 159,359.

**SUN-DEW** (*Drosera*; natural order *Droseraceae*), plants growing in bogs and marshes, having leaves clothed with reddish gland-bearing hairs, the glands exuding drops of a clear, glutinous fluid, glittering like dew-drops, whence the name. The three British species are *D. rotundifolia*, *intermedia*, and *anglica*, the differences being chiefly in the shape of the leaves. The habit of capturing insects by their viscid secretion is a characteristic of these plants well known to botanists, and has been the subject of investigation by Mr. Darwin, the results of which are embodied in his work entitled *Insectivorous Plants* (1875). From his preliminary sketch of the action of the several parts of the plant and of the manner in which insects are captured the following observations are quoted: 'If a small organic or inorganic object be placed on the glands in the centre of a leaf these transmit a motor impulse to the marginal tentacles. The nearer ones are first affected, and slowly bend towards the centre, and then those farther off, until at last all become closely inflected over the object. This takes place in from one hour to four or five or more hours. The difference in the time required depends on many circumstances, namely, on the size of the object and on its nature—that is, whether it contains soluble matter of the proper kind; on the vigour and age of the leaf; whether it has lately been in action; and, according to Nitschke (a German botanist), on the temperature of the day, as likewise seemed to me to be the case. A living insect is a more efficient object than a dead one, as in struggling it presses against the glands of many tentacles. An insect, such as a fly, with thin integuments, through which animal matter in solution can readily pass into the surrounding dense secretion, is more efficient in causing prolonged inflection than an insect with a thick coat, such as a beetle. The inflection of the tentacles takes place indifferently in the light and darkness; and the plant is not subject to any nocturnal movement of so-called sleep. If the glands on the disc

are repeatedly touched or brushed, although no object is left on them, the marginal tentacles curve inwards. So again, if drops of various fluids (for instance, of saliva or of a solution of any salt of ammonia) are placed on the central glands the same result quickly follows (sometimes in under half an hour). When a small bit of meat or an insect is placed on the disc of a leaf, as soon as the surrounding tentacles become considerably inflected, their glands pour forth an increased amount of secretion. The glands possess the power of absorption, as is shown 'by the widely different results which follow from placing drops of various nitrogenous and non-nitrogenous fluids of the same density on the glands of the disc or on a single marginal gland; and likewise by the very different lengths of time during which the tentacles remain inflected over objects which yield or do not yield soluble nitrogenous matter.' In short, the plant derives its nitrogenous food by absorption from the tissues of insects entangled on its viscid leaves; while, like other plants, it obtains and assimilates carbonic acid from the air. It becomes a question whether the leaves can only absorb matter already in solution or render it soluble—that is, have the power of digestion. Mr. Darwin shows, as the result of his experiments, that they have this power, and that they act on albuminous compounds in exactly the same manner as does the gastric juice of the higher animals, the digested matter being afterwards absorbed. The digestive faculty has also been traced in Venus's Fly-trap (*Dionaea*), Butterwort (*Pinguicula*), the Pitcher-plant (*Nepenthes*), &c. See CARNIVOROUS PLANTS.

SUN-DIAL. See DIAL.

SUN-FISH (*Orthogoriscus*), a remarkable genus of Teleostean fishes belonging to the Plectognathous (which see) division of that order, and distinguished by the very much shortened body, which is also deep and compressed from side to side; by the undivided jaws; by the tail-fin being continuous with the dorsal and anal fins, and by the absence of a swimming-bladder. The pectoral fins are of small size. These curious fishes present the appearance of having had the tail cut off along with the middle part of the body. They are not very common around the British coasts, but are occasionally met with. The two most familiar species are the *O. mola*, or Short Sun-fish, and the *O. oblongus*. Their popular name is derived from the rounded shape of their bodies, as well as from their emitting a phosphorescent light at night; the name 'Moon-fishes' being sometimes also applied to them. They generally swim near the surface of the water, and on the whole appear to be of lazy or inactive habits. The colour of the first-named species is a grayish-brown on the back, this hue becoming lighter on the sides and belly. The skin is of hard and leathery nature. These fishes are captured chiefly by harpooning them, their immense weight rendering their transit a matter of difficulty. The average length is about 4 or 5 feet, whilst in some cases they may attain a weight of from 300 lbs. to 400 lbs. The flesh is very soft, and is white and palatable, and somewhat resembles that of the skate. The liver is large, and yields an oil highly valued amongst sailors as a cure for rheumatism. The eyes of these fishes are distensible in structure, and can be retracted when they are alarmed. The *O. oblongus* is of more oblong shape than the preceding species, but otherwise resembles the Short Sun-fish, a young specimen of which is shown at ICHTHYOLOGY, Pl. III., fig. 20.

SUN-FLOWER (*Helianthus*), a genus of plants, of the natural order Compositae, so called from the ideal resemblance of the yellow flowers to the sun

with his golden rays. The root is mostly perennial; the stem herbaceous, upright, and often tall; the leaves opposite or alternate, undivided, often rigid and scabrous; the flowers large and terminal, usually disposed in a corymb. The species are numerous, and mostly inhabit North America. The gigantic sun-flower (*H. annuus*), so common in our gardens, is a native of Peru. The root is annual; the stem thick, cylindrical, rough, from 6 to 15 feet in height; the leaves alternate, petiolate, large, and somewhat heart-shaped; the flowers, sometimes 1 foot in diameter, are so inclined as to take nearly a vertical position, and usually are turned towards the south; they have the disc very large, and the rays short in proportion. The seeds form excellent nourishment for poultry and for cage-birds; and an edible oil has also been expressed from them. For the *Helianthus tuberosus*, or Jerusalem artichoke as it is commonly called, see ARTICHOKE.

SUNNA. See next article.

SUNNITES, the so-called orthodox Mohammedans, in contradistinction to the Shiites or heterodox Mohammedans. They form by far the larger of the two divisions, embracing the Mohammedan inhabitants of Egypt and the rest of Africa, Syria, Turkey, Arabia, and Tartary, while the Persian Mohammedans are the principal Shiites. The chief points of difference between the two sects are the three following:—The Sunnites recognize the first three caliphs, Abubekr, Omar, and Othman, as rightful successors of Mohammed, while the Shiites reject them, holding Ali, the son-in-law of Mohammed, to be his first legitimate successor; secondly, they do not cherish the memory of Ali with any peculiar regard, while the Shiites look upon him as at least equal in sanctity to the founder of their religion; thirdly, the Sunnites receive the Sunna (that is, a collection of traditions relating to Mohammedanism) as of equal importance with the Koran, while the Shiites reject it absolutely. There are several diversities in the copies of the Sunna. And the Sunnites are subdivided on account of some minute differences of custom and law into four minor sects.

SUNSTROKE arises most commonly from exposure to the direct rays of the sun, particularly when the back of the head and neck are the parts on which the sun's rays beat. A form of sunstroke, also called heat-fever, occurs in persons working in confined spaces where the air is heated to a high temperature, specially if the persons are in a depressed condition of health. The symptoms are those of shock, the person usually dropping insensible to the ground, with feeble pulse and laboured breathing. In some cases there is high fever, and the skin of the head and face is livid and congested. Sometimes there are no very marked symptoms at the time of the occurrence, and the effects of the stroke can be discerned only in impaired bodily health or mental vigour dating from some occasion of exposure. The immediate treatment consists in the use of the cold douche to the head and back of the neck.

SUPERANNUATION. Persons employed in the civil service of Great Britain are entitled, on reaching the age of sixty, to superannuation allowances as soon after that age as they please to retire, and after ten years' service if compelled to retire before the age mentioned by bodily or mental infirmity. The mode of computing such allowances is chiefly regulated by Act 22 Vict. cap. xxvi. The amount of the allowance is there fixed at  $\frac{1}{4}$ th of the annual salary on retirement after ten years' service, and an additional sixtieth for every further year of service until a service of forty years has been completed, after which no addition is made to the proportion

of the superannuation allowance. The largest superannuation allowance is thus two-thirds of a civil servant's salary. Special provision is, however, made for such offices as in the opinion of the treasury require special qualifications, making it desirable in the public interest that older men than usually enter the service should be appointed to fill them. With regard to these it is provided that in computing the superannuation allowance that the holders of them are entitled to, a certain number of years not exceeding twenty may be added to the actual number of years of service, and that the allowance may be granted after a less period than ten years' service. If a civil servant not coming under the last-mentioned exception is obliged to quit the service in consequence of bodily injury sustained in discharge of public duty within ten years after entering it, a gratuity may be allowed him not exceeding three months' pay for every two years' service, or an annuity not greater than one-sixth of his annual salary. Gratuities not exceeding one month's pay for every year of service may also be granted to officers compelled by infirmity of body or mind to quit the service within ten years. When an office is abolished a reasonable annual allowance as compensation is to be allowed, but in no case is this allowance to exceed two-thirds of the salary. The allowance may in all cases be increased for special services, and diminished in respect of fault or demerit, and where the officer has been guilty of any grave offence it may be refused altogether. By an act passed in 1898 provision was made for granting annuities to teachers in elementary schools on reaching the age of 65. They have to make an annual contribution while in active service towards a fund for this purpose.

**SUPERCARGO**, a person charged with the accounts and disposal of the cargo, and with all other commercial affairs in the merchant-ship in which he sails. He differs from a factor in that the latter has a fixed residence, and does not go out and return with the ship.

**SUPEREROGATION, WORK OF.** See **INDULGENOE**.

**SUPERFETATION**, the name applied to indicate the phenomena occasionally exhibited in pregnancy, in which a female, already pregnant, conceives a second time before the birth of the first child. In other words, conception again occurs whilst an embryo is in course of development. For example, a woman may be delivered of a full-grown child and of an undeveloped embryo at the same time, the period of conception of each being presumed to be different. Again, a woman may be delivered of two living children, the one appearing much more developed than the other. Or, lastly (as in an actual case occurring at Charleston, South Carolina, in 1714), a negro woman may give birth to twins; the one child being of black colour and the other being white. In this, and other certified cases of the same kind, each child had a distinct parent, the occurrence proving the possibility of a double conception. But unquestionably far more typical cases of superfetation have been found. Such, for example, are those instances in which, as published by Eisenman of Strasburg, a woman was delivered of a second child 140 days after the first, both children being fully developed. In this case, therefore, the second child must have been conceived at a later and different period from the first; and the development of the second child must have been proceeding separately from that of the first, and after the latter was born. In this woman, it may here be noted with a view to the explanation of such cases, the uterus or womb existed in its normal and single condition. In another case,

related by Desgranges of Lyons, a woman gave birth to a child on January 20, 1780, which had apparently attained the intra-uterine age of seven months; and on July 6th, 1780, five months and sixteen days after the birth of the first child, she bore a second of full development. In a third case, a woman gave birth, on November 12th, 1807, to a fully-developed child, and to another of full growth on February 2, 1808, hardly three calendar months after the birth of the first.

The explanation of these curious cases has afforded a very intricate study and puzzle to obstetricians and physiologists. The first point which naturally offers itself for solution is whether or not conception may re-occur after the first conception, and whilst the uterus already contains a developing foetus. In cases in which a blighted and a full-grown child are born together, or within a very short period of each other, the phenomena may be held to be not those of superfetation at all, but simply those of a twin-pregnancy, in which, as is very frequent, one of the embryos is developed, and the other, from some cause, is not developed at all. There is no need in this first instance to assume the fact of a second conception at a widely different period from the first. Again, where children of different colours are born at the same time the case may still lie without the boundaries of the phenomena of true superfetation, for it simply proves that double conception by different fathers can take place within a short period of each other. The latter cases we have cited, in which a second fully-developed child is born three, four, or five months after the birth of the first, are less easy of explanation, and are really cases of superfetation,—if indeed the occurrence of this condition be admitted at all by obstetricians. In explanation of such cases it has been argued that the human uterus may be *double* in some cases, as in some lower animals, and that in each of its cavities a foetus may be contained and undergo development independently of the other. Cases of double uterus are not unknown in the human female, and in one instance, related by Madame Boivin, this condition probably was present, and explained the fact that the patient, who bore a child on the 15th March, 1810, gave birth to a second child on the 12th May of the same year. But a double womb cannot be present in all cases, as was actually proved in a case, and related by M. Bigaud, in which a woman, who, after death, was ascertained to possess a single and normal uterus, gave birth to a *second* mature child four and a half months after the birth of the first. Some obstetricians have argued that, although the womb is already fully occupied by a developing embryo, and although the after impregnation of a fresh ovum (see **MENSTRUATION** and **OVUM**) is a process the probability of which is very difficult to admit, there yet is the possibility of impregnation again being effected. So that a woman pregnant say for three months might still conceive again after intercourse, from the process of development of the embryo admitting of a fresh ovum being fertilized. Beyond this period of three months it would, it is considered, be almost impossible for a second impregnation to occur. As the subject at present stands, its full elucidation is still a matter for obstetrical investigation; but there can be little doubt either of the actual occurrence of cases of superfetation, or of the great importance of the study of its phenomena.

**SUPERIOR**, in Scots law, the original grantor or heir of the original grantor of heritable property, granted under the condition that the receiver of the grant and his successors shall pay to the original grantor and his successors a certain sum of money annually, or render them certain services. The

grantee and his successors are called, in relation to the superior, vassals. The relation of the superior to the property so granted is called *dominium directum*, while the right of the vassal in the property is called *dominium utile*. The superior has no other right in connection with the property than to receive the money (usually called *feu-duty*) or services which constitute the condition of the grantee's tenure. All other rights belong to the grantee or vassal.

**SUPERIOR, LAKE**, the largest expanse of fresh water in the world, and the most westerly and most elevated of the great lakes of the St. Lawrence basin; lat. 46° 30' to 49° N.; lon. 84° 30' to 92° 20' W. It washes the shores of the state of Minnesota on the west, those of Wisconsin and the northern peninsula of Michigan on the south, and those of Canada (Ontario) in all other directions; greatest length, measured on a curve through its centre from east to west, 420 miles; greatest breadth, 167 miles; circuit, about 1750 miles; estimated area, 31,200 sq. miles (about the size of Ireland); height above sea-level, 602 feet; approximate mean depth, 900 feet. It is of very irregular shape, widening out towards its centre, and gradually narrowing, partly towards its eastern, but much more towards its western extremity, so as to form an irregular crescent, with its convexity on the north and its concavity on the south. The northern shore is generally bold and elevated, presenting almost continuous ranges of cliffs, which vary in height from 300 to 1500 feet; the southern shore is low and sandy, though occasionally interrupted by limestone ridges, the most remarkable of which, situated toward the eastern extremity, present a perpendicular wall 300 feet high, broken by numerous caverns and projections, and forming, under the name of the Pictured Rocks, one of the greatest natural curiosities of the United States. The central portion of the lake is clear of islands, but these are numerous towards both the southern and the northern sides. In the former direction they are small, and, being insufficient to give shelter behind them, only increase the difficulties of the navigation without contributing to form a single good harbour. In the latter direction several of them, more especially the Isle Royale, are of considerable dimensions, and along with the indentations of the coast afford good shelter for vessels. The water of the lake is remarkable for its transparency, and derives its supplies from a basin which is estimated at 54,000 square miles, and is drained by more than 200 streams. About thirty of these are of considerable size, but they are almost all impetuous torrents, interrupted by rocks and rapids. It discharges into Lake Huron, at the south-east end, by St. Mary's River, which at Sault Ste. Marie descends 22 feet in three-quarters of a mile, navigation being here carried on by means of two ship canals, one on the Canadian, the other on the United States side. Within the lake itself the only obstruction to its navigation are the violent gales to which it is subject. It is well supplied with fish, principally trout, white-fish, and sturgeon. There are a great number of fishing-stations. Large deposits of copper and iron are worked on the shores of the lake. The boundary-line between Canada and the United States in passing through Lake Superior proceeds from the outlet nearly through its centre till it approaches Isle Royale, when it bends north, so as to give that island entirely to the United States, and is then carried s.s.w. to its termination at the mouth of the Pigeon, in lat. 48° N. The chief towns on the shores of Lake Superior are Duluth (Minn.); at the western extremity, with an excellent harbour; Superior (Wis.), near Duluth; Fort William (Ontario), also with a good harbour; and Port Arthur (Ontario).

#### SUPERIOR PLANETS. See PLANETS.

**SUPERNATURALISM**, a word often used as contradistinguished from *rationalism*. It is difficult to give any satisfactory view of these conflicting religious opinions within our limits, but the subject is too interesting to be wholly passed over. In its widest extent supernaturalism is the doctrine that religion and the knowledge of God require a revelation from God. But, generally speaking, the words *supernaturalism* and *rationalism* are used particularly in reference to the Christian religion. Rationalism maintains that the Christian religion must be judged of, like other phenomena, by the only means which we have to judge with, namely, reason. Supernaturalism considers the Christian religion as an extraordinary phenomenon out of the circle of natural events, and as communicating truths above the comprehension of human reason. These views are variously modified, and as is the case with all important questions, many believe that both run into extremes; that in the one too much is claimed for human reason, whilst in the other feeling has an undue ascendancy; that supernaturalism has depth without clearness, and rationalism, such as we have represented it, clearness without depth. A third or intermediate party, who by some have been termed *rationalists*, whilst the extreme party are called *hyper-rationalists*, say that supernaturalism removes religious truth beyond the sphere of the human understanding, and even beyond the possibility of recognition. If, say they, divine truth is something which comes entirely from without, and is unconnected with other truth, where is our capacity to recognize it? The revelation of the omnipresent Ruler of the world, which pervades all ages, is, they further say, annihilated if Christianity has no connection with that revelation or manifestation, and if it is essentially different from what existed before or without it. On the other hand, they allow that the hyper-rationalists misunderstand the character of human reason, and oppose it to Christianity so as to reduce this to an ordinary subject of human judgment. Christianity they consider as intermediate between these two views, as presenting in Christ the sublimest union of man with God, whilst it leaves to theological science the task of unfolding the full extent of revealed truth. See **RATIONALISM**.

**SUPPLY, COMMISSIONERS OF**, were the persons appointed to value lands and heritages in Scotland with a view to the assessment of the land-tax. The qualification to act as a commissioner at one time consisted in being named as an *ex officio* commissioner in any act of supply, or in being a proprietor or the husband of a proprietor of lands and heritages within the county of the yearly rent or value, in terms of the act, of £100, or of houses of the yearly value of £200, or being eldest son or heir-apparent of a proprietor of £400 yearly value, or factor of an absent proprietor of £800 yearly value. By 19 and 20 Victoria, cap. xciii. (1856), all persons qualified otherwise than by being named in an act of supply are entitled to act without being so named. The chief duty of the commissioners was to assess the land-tax and apportion the valuation according to the provisions of the Valuation of Lands Act, 17 and 18 Vict. cap. xci. They managed the general expenditure of the county, and levied the necessary assessments for this and other purposes; they appointed the various county officials, and had the management of the county police. By 31 and 32 Vict. cap. lxxxii. (1868) they were declared an incorporation, and as such could hold property and sue or be sued. The commissioners at their annual meeting on 30th April used to appoint a committee of their number (three a quorum) to dispose of claims by persons who desired

to be put upon the list, and of objections. A valuation roll showing the yearly rent or value of the whole rents and heritages of the county had to be made up annually. For this purpose the commissioners were authorized to appoint assessors, and a court had to be held between the 10th and 15th of September to hear appeals from the valuations of the assessors. Since the passing of the Local Government Act of 1889 the position and functions of this body have been greatly altered, their duties and powers having been almost entirely transferred to the County Council. Lists of commissioners are still made up as before, however, and they meet annually on the same day of May as the County Council, and at the same place, and appoint a convener for their body as well as members (not more than seven), to form along with a like number of county councillors a standing joint committee for the county.

**SUPPLY, COMMITTEE OF.** In Britain all bills granting supplies of money for public service must originate in the House of Commons, and according to the rules of procedure of that House questions of supply must first be considered in a committee of the whole House. This committee is called a committee of supply. In committee members of the House may speak repeatedly on the same question. The committee of supply, like other committees of the whole House, has no power to adjourn, but is appointed to sit again by the House from time to time when the question of supply comes up. The committee of supply only considers the estimates submitted to it by the government, and votes the sums to be appropriated for the various services; the means of raising these are discussed in a committee of ways and means. These two committees sit from time to time during the greater part of the session. When the House resumes, the resolutions passed in committee must be reported to it, reconsidered, and received. At the close of the session the resolutions approved of are consolidated into an appropriation bill, which is sent up to the House of Lords, where it is either passed or rejected without amendment. Committees of the whole House are not presided over by the speaker, but by a separate chairman, appointed at the beginning of each session of Parliament, and who is a salaried officer.

**SUPPORTERS.** In heraldry, figures placed by the side of the escutcheon, and seeming to support or hold up the same. They are sometimes human figures, and at other times animals and creatures of the imagination. See **HERALDRY**.

**SUPURATION.** See **INFLAMMATION**.

**SUPRA-RENAL CAPSULES,** the name applied to two glandular bodies which exist, one at the front portion of the upper end of each kidney. These glands are generally classified with the spleen (which see) and other structures under the head of *ductless glands*; and regarding their exact functions considerable doubt and uncertainty exist. Each supra-renal capsule exhibits a yellowish colour; that of the right kidney being somewhat of triangular shape, the left being of somewhat crescentic form. In some cases these bodies may be hardly recognizable on account of their minute size; but their average dimensions are from about  $1\frac{1}{2}$  inch to 2 inches in length, by about the same or rather less measure in width, and from 2 to 3 lines in thickness. Their average weight is about 1 or 2 drachms. Each capsule is connected to its kidney by areolar tissue only, no vascular or other connections existing between the glands; and neither capsule has any outlet or excretory duct. They lie behind the peritoneum or lining membrane of the abdomen, the front surface of the right supra-renal capsule being in contact with the under surface of the liver, the same surface of the left being in rela-

tion with the pancreas or sweet-bread and spleen. The surface of the glands is invested by areolar tissue containing much fatty materials. Like the kidneys these capsules are seen in longitudinal section to be composed of an outer or cortical and of an inner or medullary portion, the former making up the greater part of the organ. This cortical part is of deep yellow colour, the internal substance being of dark brown or black hue, and being soft and pulpy. It consists of masses of cells of varying size and shape. Three zones of these cells are distinguished. Each zone consists of a connective tissue framework; the spaces left by the framework in the outer zone are small and roundish, and being filled with cells present a granular appearance. The spaces of the middle zone are elongated, and the cells they contain thus present a columnar appearance, while the inner zone is reticulated. The cells are flattened and epithelioid with well-marked nucleus and nucleolus. Along the connective tissue framework closely investing the columns and masses of cells is a close-set net-work of capillary vessels, and lymphatic vessels are also very numerous. The central or medullary portion of the capsules consists also of cells in groups in a connective tissue framework, the cells being irregular and branched. The capsules derive their blood from the *aortic, renal, and phrenic arteries*, and return their blood by the *supra-renal vein*, which receives its blood from the net-work of the medullary portion, and also partly from the cortical substance of the organ. The nerves of the supra-renal capsules are numerous, and are branches of the *solar and renal plexuses* and of the *phrenic and pneumogastric trunks*. The supra-renal capsules are present in all mammals, and are largest in Rodentia, and smallest, proportionally, in the whales, in which they are lobulated or divided into lobes. In birds they are of small size, and exist generally on the inner aspects of the kidneys. In sharks they exist as a single, long, lobular organ lying behind the kidneys; and in frogs and toads they appear as yellowish patches on the kidney. They are also lobular in sturgeons and other fishes, and in newts and Urodela generally.

Regarding the exact functions of these bodies nothing definite is known. Before birth they assume a much larger size than the kidneys themselves, up to the tenth or twelfth week of human development; whilst they afterwards diminish greatly in size relatively to the kidneys, and possess in the adult only about  $\frac{1}{4}$ th of their original bulk. That these bodies may have some important function to discharge in connection with the blood-circulation of the embryo is a highly reasonable suggestion; but further than this general statement physiology cannot certainly proceed. A fact of much interest in connection with these bodies, however, has been observed in cases of what is known as *Addison's disease*—a lesion marked by anemia or bloodlessness and disordered system as prominent symptoms. In this disorder a peculiar bronzing or discoloration of the skin exists, and it is alleged that this latter feature is due to disease of the supra-renal capsules. Dr. Addison observed that severe cases of anemia and debility terminated fatally, and exhibited this discoloration of the skin; and he was thus led from his investigations to assign to a diseased state of these capsules the *fons et origo mali*. The connection between the bronzing of the skin and disease of these capsules, however, is, to say the least, hardly proved. And the sequence by many physicians is entirely doubted. The actual diseases to which these bodies are liable, consist of *hypertrophy* or enlargement, *atrophy* or wasting, *tuberculous degeneration*, *fatty disease*, and occasionally *cancerous infiltration*.

**SUPREMACY.** According to the Roman Catholics St. Peter was not only the head of the apostolical college, but the pastor of the universal church. The Roman pontiff is the successor of this prince of the apostles, and, like him, has authority and jurisdiction over the whole church, all believers, without exception, owing him respect and obedience. The Council of Trent declared that the sovereign pontiff is the vicar of God upon earth, and has supreme power over all the church. The extent of the authority thus assumed by the pope is different in different countries, and the whole doctrine of the Papal supremacy is of course rejected by the Protestant, Greek, and other churches. In 1534 Henry VIII. assumed the title of the only supreme head on earth of the Church of England. The *oath of supremacy* (that is, of renunciation of the Papal supremacy), with the oath of abjuration (adjuring allegiance to any but the present royal family), was formerly required to be taken by all persons in office, and might be tendered by two justices of the peace to all persons suspected of disaffection in England. Some modifications of the law requiring this oath were made in 1793; but it was still, with the declaration against transubstantiation, the invocation of saints, and the sacrifice of the mass, requisite as a qualification for sitting and voting in Parliament, and for holding certain offices, until the passage of the Catholic Relief Bill, when different forms were substituted. For the oaths at present required of members of Parliament, see *OATHS*.

**SUPREME COURT OF JUDICATURE,** a legal tribunal in which are united all the higher courts of justice in England, exclusive of the appellate jurisdiction of the House of Lords and of the privy-council. For the constitution of this tribunal an act was passed in 1873 (36 and 37 Vict. cap. lxxv.) entitled the Supreme Court of Judicature Act, 1873. The act was fixed to come into force on 2d November, 1874; but in 1874 an act was passed (37 and 38 Vict. cap. lxxiii.) postponing the commencement of the act to 1st November, 1875; and in 1875 an Amending Act (38 and 39 Victoria, cap. lxxvii.) was passed, to be cited separately as the Supreme Court of Judicature Act, 1875. The Amending Act provided that the act should come into force on 1st November, 1875, but that the 20th, 21st, and 55th sections of the principal act, transferring the appellate jurisdiction of the House of Lords and the privy-council to the supreme courts, should come into force on 1st Nov. 1876. Before this time, however, a fresh act was passed in reference to the appellate jurisdiction of the House of Lords, by which it was provided that appeals could be carried to the House but should not be heard unless in the presence of three Lords of Appeal, namely the lord-chancellor and two Lords of Appeal in ordinary to be appointed under the act. Another amending act was passed in 1877.

The High Court of Chancery, the Court of King's Bench, the Court of Common Pleas, the Court of Exchequer, the High Court of Admiralty, and the Courts of Probate and Divorce were accordingly united into one court, which is known as the Supreme Court of Judicature. This court again consists of two permanent divisions, called His Majesty's High Court of Justice and His Majesty's Court of Appeal, the latter having only appellate jurisdiction, with such original jurisdiction as may be necessary to dispose of cases of appeal. The High Court of Justice is now organized in three divisions, named respectively the King's Bench Division, comprising the courts of King's Bench, Exchequer, and Common Pleas; the Chancery Division; and the Probate, Divorce, and Admiralty Division. It consists of

the judges of the courts named, judges appointed by letters-patent, not as judges of any particular part of the court, but as judges of His Majesty's High Court of Justice. The titles of Lord Chief-justice of England, Master of the Rolls, Lord Chief-justice of the Common Pleas, and Lord Chief-baron are to be continued, and the holders to occupy their respective offices as hitherto. The two latter offices are now merged in that of the Chief-justice of England. The ordinary judges (or justices) of the High Court are to have equal power, authority, and jurisdiction. The lord-chancellor is to be president of the High Court, and the lord chief-justice is to preside in his absence. The lord-chancellor, however, is not to be deemed a permanent judge of the court. The Court of Appeal consists of four *ex officio* judges, and of five ordinary judges appointed by letters-patent. The title of the ordinary members of the court is Lord Justices of Appeal. The *ex officio* judges are the lord-chancellor, the Lord Chief-justice of England, the Master of the Rolls, and the president of the Probate, &c., Division. The lord-chancellor is to be president. To be a barrister of ten years' standing qualifies for the appointment of judge of the High Court of Justice; for the Court of Appeal the qualification is to be a barrister of fifteen years' standing, or alternatively to have been a judge of the High Court for the period of a year. All judges except the lord-chancellor shall hold office during good behaviour, subject to power of removal by her majesty on an address from both houses of Parliament, the rights and titles of existing judges being provided for.

The High Court is to be a superior Court of Record, and is to have vested in it the jurisdiction previously exercised by the Court of Chancery as a common law court and as a court of equity, including the jurisdiction of the master of the rolls, as a judge or master of the Court of Chancery, and any common law jurisdiction exercised by him as a judge of Chancery, any jurisdiction exercised by the Court of King's Bench, the Court of Common Pleas at Westminster, the Court of Exchequer as a court of revenue and a common law court, the High Court of Admiralty, the Court of Probate, the Court for Divorce and Matrimonial Causes, the Court of Common Pleas at Lancaster, the Court of Common Pleas at Durham, the courts created by commissioners of assize, of Oyer and Terminer, and of jail delivery. The jurisdiction not transferred to the High Court consists generally in appellate jurisdiction, and includes also the jurisdiction of the lord-chancellor over lunatics, patents, and over colleges and charitable foundations as visitor, and the jurisdiction of the master of the rolls in relation to records. The Court of Appeal is to be a superior court of record, and to have all the jurisdiction of the lord-chancellor and of the Court of Appeal in chancery, as a chancery court, and also as a court in bankruptcy; the jurisdiction of the Court of Appeal in chancery of the County Palatine of Lancaster, and the separate appellate jurisdiction of the chancellor of the county; the jurisdiction of the Court of the Lord-warden of the Stannaries; the jurisdiction of the exchequer chamber; the jurisdiction vested in her majesty in council or the judicial committee of the privy-council upon appeal from the Court of Admiralty or from the lord-chancellor, or other person having jurisdiction in lunacy. For the disposing of appeals the Court of Appeal shall have all the powers of the High Court. The jurisdiction in relation to persons of unsound mind of the lords justices of appeal in chancery is to be intrusted by sign-manual to particular judges of the High Court of Justice or Court of Appeal, the present lords jus

tices continuing to exercise it during their tenure of office. The chief judge of bankruptcy is to be one of the judges of the High Court appointed by the lord-chancellor, and appeal is to lie from the Court of Bankruptcy to the Court of Appeal. All appeals and petitions to his majesty in council shall be referred to the Court of Appeal, to which is transferred, for the purpose of hearing them, all the powers of the judicial committee of council. In hearing ecclesiastical appeals the court shall be composed of judges and assessors, the latter being archbishops or bishops of the Church of England. The division of the legal year into terms is abolished as far as the administration of justice is concerned, but is retained for the determining of periods within which particular acts may be done. The courts and any of the judges are at liberty to sit at any time or place. Commissions of assize on circuit are continued. Parties may, subject to rules of court, require cases to be tried at Middlesex. The courts for trial by jury at Middlesex are to sit as far as practicable throughout the year. The distribution of business is based on existing practice. Every document by which a cause is commenced must be marked with the name of the division or judge to whom it is to be assigned. Matters not proper to be heard by a single judge are to be heard by divisional courts of the High Court, any number of which may sit simultaneously. Divisional courts are to consist of three, or not less than two, judges. Every judge of the High Court may sit in any divisional court, and the senior judge present shall preside. All arrangements for divisional courts are to be made by a majority of the judges with the concurrence of the lord-chancellor. Plaintiffs may assign causes to any judge of the proper division they may think fit. Appeals from petty or quarter sessions, county courts, or any inferior court from which an appeal might be brought before any of the transferred courts, may be determined by the divisional courts of the High Court. The determination of these divisional courts is to be final, unless the court gives special leave to appeal to the Court of Appeal. Any judge of the High Court has power to reserve any point in a case before him to be heard by a divisional court. Reserved crown cases are to be determined by five judges (one of which judges, it is prescribed, must be the lord chief-justice), and such determination is to be without appeal. No appeal is to lie from any judgment of the High Court in criminal matters except for error of law apparent on the record, and regarding which no question has been reserved. Motions for new trials, in arrest of judgment, nonsuit, reduction of damages, &c., are to be heard before a divisional court; and no appeal from any judgment founded upon, or applying a verdict, shall be allowed unless proceedings shall have been taken before a divisional court to set aside such verdict, or the judgment founded thereon, in which case an appeal shall lie from the decision of the divisional court to the Court of Appeal. The Court of Appeal may sit in two sessions simultaneously.

**SURABAYA.** See **SOURABAYA.**

**SURAKARTA.** See **SOURAKARTA.**

**SURAT**, a town of India, in the presidency of Bombay, capital of a district of same name, on the left bank of the Tapti, about 14 miles above its mouth in the Gulf of Cambay. It is nearly in the form of a semicircle, of which the river forms the diameter or chord, the length along the river being about a mile and a quarter. Near the centre stands the castle, which, though small, has bastions, covered-way, and glacis. It is now occupied by public offices. The town, in the central quarter, consists of narrow

well-kept streets lined with lofty houses, of which the upper story, formed of a framework of timber filled up with brick, projects beyond the base. The suburbs are open and straggling, and thus cover a wide area. Westward of the town is the military cantonment, with its parade-ground stretching down to the water's edge. Among the chief buildings are some handsome mosques and Mohammedan tombs, Hindu and Parsee temples, English, R. Catholic (Portuguese), and Armenian churches, clock-tower, high-school for boys, &c. Towards the end of the eighteenth century Surat was in a flourishing state, but lost much of its manufactures by British competition and its trade by the silting up of its harbour. It still exports cotton. Pop. (1891), 109,229; (1901), 118,364.

**SURD.** See **IRRATIONAL QUANTITIES.**

**SURETY.** See **GUARANTEE.**

**SURGEON-FISH.** See **SEA-SURGEON.**

**SURGEONS, ARMY AND NAVY.** The medical and surgical service of the British army is now intrusted to a regularly-organized body known as the Royal Army Medical Corps. This corps is under the control of the director-general of the Army Medical Department, who is the head of one of the sections of the Military Department of the War Office. The director-general is also responsible for the management of the military hospitals, and he has the assistance of a staff of surgeons of superior rank. The Royal Army Medical Corps, besides a number of surgeon major-generals and colonels, comprises about 800 officers of lower rank, besides quarter-masters, apothecaries, &c. The principal medical officer and the senior surgeons are responsible for the sanitary service in the military districts, the other officers being employed on active duty with the troops or in the hospitals. The corps consists of nineteen companies and a dépôt, the latter being at Aldershot. Three companies are located at Aldershot, two at Netley, where the Royal Victoria Hospital is situated. The Army School of Medicine at Netley is managed by a committee of military surgeons. Its staff is partly military and partly civilian, but wholly medical. In it young officers are trained in the duties of a military surgeon. Naval surgeons prosecute their studies in the Navy Medical School attached to the Naval Hospital at Haslar.

**SURGEONS, ROYAL COLLEGE OF (ENGLAND).** As stated in the article **SURGERY**, the body from which the Royal College of Surgeons of England is descended is the Company of Barber-surgeons, incorporated by royal charter in 1461, the first year of Edward IV. They had authority to examine all instruments and remedies employed, and to bring actions against any person that practised ignorantly or illegally, that is, without being examined and admitted by competent masters of the company. A separate association of surgeons having been formed, by persons who practised in defiance of the barbers' charter, an act passed in the third year of Henry VIII. prohibited any person from practising as a physician or surgeon within 7 miles of the city of London without being examined and admitted by the Bishop of London, the Dean of St. Paul, or four doctors of physic; or for surgery, other expert persons in that faculty. In 1540 the two companies of barbers and surgeons were united into one corporation under the title of Masters or Governors of the Mystery and Commonalty of Barbers and Surgeons in London. In 1745 the unnatural union between barbers and surgeons was dissolved, and the latter raised from the second place in this degrading connection into a separate corporation by act 18 George II. cap. xv., which also preserved to the bar-

bers their right to act as surgeons. A new charter was granted to the corporation in 1800, in which the title of the company was altered from that of Masters, Governors, and Commonalty of the Art and Science of Surgeons to that of the Royal College of Surgeons in London. By another charter, granted in 1843, the title of the corporation was changed to that of the Royal College of Surgeons of England, and the college was authorized to create a portion of its members fellows, with the title of Fellows of the Royal College of Surgeons of England. The number of fellows was to be not less than 250, nor more than 300. The fellows were to be elected by the council on examination, but in 1852 power was given to elect members of fifteen years' standing without examination. The government of the college is vested in a council of twenty-four members, including a president and two vice-presidents, the whole to be fellows of the college. Three members go out annually by rotation, and their successors are elected by the fellows. Examining bodies are appointed to test the qualifications of candidates for fellowships, as well as of those seeking to be admitted as members. The examiners hold office during the pleasure of the council. The college also appoints special examiners in dental surgery, and in various departments of scholarship. It has connected with it the Hunterian professorship of comparative anatomy and physiology, a professorship of human anatomy and surgery, a professorship of dermatology, and lectureships in various subjects. The examination for membership of the college includes a preliminary examination in general scholarship, as well as a professional examination. By the Medical Act, 1858, the college sends one delegate to the general medical council, and is one of the bodies named in the act as authorized to license practitioners of medicine within the United Kingdom. The fellows and members take respectively after their names the initials F.R.C.S. and M.R.C.S.

The buildings of the college are on the south side of Lincoln's Inn Fields, and were erected from designs of Sir Charles Barry in 1835-37 at a cost of £40,000. They contain a museum, library, and theatre for lectures. The museum originated in the purchase by Parliament (for £15,000) and presentation to the college of the admirable collection of John Hunter. It is one of the most valuable scientific collections in the world. An oration is delivered annually, on the supposed anniversary of the birth of John Hunter, in honour of Hunter and others who have rendered distinguished services to medical science.

**SURGERY** (the English form of the Greek *cheirurgia*, from *cheir*, the hand, and *ergein*, to work), the operative branch of medicine, or that part of the medical art which is concerned with the removal of injured parts or organs, or with the healing of lesions by means of operations on the parts affected, either by the hand or with instruments. Surgery forms neither a complete art nor an independent science, yet it embraces a field so wide and complicated that it is only by the independent investigations of many students in its various branches that its practice can be successfully maintained, and the theories connected with it promoted.

Celsus observes that after the time of Hippocrates the medical art was divided into three parts—curing by regimen, by medicine, and by manual operations; these were called the dietetic, pharmaceutical, and surgical departments of medicine. This division is unexceptionable in as far as it recognizes the unity of the medical art, and intimates the close connection between its various sections as representing separate and possibly conjoint means of accomplishing a common end; but surgery early became separated, for practical ends, from medicine, and by a

natural expansion came to embrace two parts—the science pertaining to surgical operations, and the art required for conducting them. From this arose a mischievous distinction which has even up to the present time affected the method of schools and of treatises on the various branches of the medical art, that between medical and surgical cases. We have thus surgical and medical anatomy, surgical and medical pathology, surgical and medical therapeutics, and surgical and medical clinics. Various attempts have been made to put this division on a scientific basis; thus surgical pathology has been distinguished as external and medical as internal pathology; but it was never possible to draw a complete line of demarkation on this basis, and the progress of science has both extended the domain of surgery and made the relations between it and medicine more intimate. Another distinction, which shares the same fate and on the same grounds, is that which defines surgery as the mechanical department of medicine. The distinction between medicine and surgery is purely one of practical convenience, and it does not subserve this end that it should be carried out absolutely. There are no serious surgical cases where medical aid is not required, and there are no medical cases where the art of the surgeon may not be called for. When a patient is in the hands either of a physician or a surgeon ignorance of the symptoms requiring a change of treatment from the one method to the other may be fatal, and without competent skill these symptoms cannot be promptly enough distinguished; although, therefore, the special studies of the physician or surgeon may be in a particular direction it is essential that each should have a well-grounded knowledge of his entire art. Boyer, an eminent French surgeon, gives a classification of surgical maladies the barest outline of which will show the futility of any absolute distinction between medicine and surgery. The cases are first divided into general and local. The former comprise (1) inflammations, (2) abscesses, (3) gangrenes, (4) burns, (5) wounds, (6) tumours, (7) ulcers, (8) fistulas, (9) bone and joint diseases; the local cases include maladies of the head, the face and facial organs, the neck, breast, belly, urinary passages, reproductive organs, and the members.

Surgery has often been contrasted with medicine in regard to its superior promptitude and certainty. In this respect it has been represented as a sort of higher grade of the medical art. Among the aphorisms of Hippocrates there is one to the effect that what is not cured by medicine may be cured by iron, what is not cured by iron may be cured by fire, what is not cured by fire is incurable. But in all such comparisons it must be borne in mind that there are two sides to the question. If surgery often cuts the knot which medicine fails to untie, to how many complications of its own does it give rise? how numerous are the accidents attending and resulting from surgical operations? and how subtle and unforeseen are often the results of dealing violently with the complicated mechanism of the human frame? In such cases what would be the art of the surgeon without the skill of the physician? if the former sometimes spares the pains of the latter he often bequeaths him his most difficult and delicate cases. The contrast between medicine and surgery has been carried further in regard to the appliances and skill respectively required of them. Owing to the serious and irrevocable nature of operations the surgeon, it is said, requires a more precise diagnostic than the physician. Medicines, if they are not beneficial, are often innocuous, and may be given experimentally; but an operation cannot be recalled, and it is therefore more indispensable that its consequences should

be well calculated beforehand. The surgeon also, it is said, requires a much more intimate and extended knowledge of anatomy, because the medical treatment of similar affections in different parts of the body is commonly analogous, while the particular structure of each part essentially affects the treatment of the surgeon. It would be safer to say that while both methods demand in extreme and difficult cases the utmost skill, the need of extreme accuracy and precision is perhaps more common in the surgical than in the medical department. On the other hand the etiology of surgery is commonly more direct and simple than that of medicine, the former being chiefly concerned with the mechanical observation of local lesions, the latter requiring the tracing of symptoms, often themselves obscure, up to vital processes.

The origin of surgery may be held to be coeval with the human race. The obstetric branch, at all events, would require to be practised in some rude form from the earliest period. The practice of surgery, as of medicine, was early associated with religion. Larrey found under the vaults and walls of the temples of Thebes, Luxor, and Denderah, bas-reliefs representing amputations effected by instruments similar to those of the present day, and such instruments are likewise found among the hieroglyphics. According to Herodotus the medical art was divided in Egypt into numerous branches, in which each member of the body was represented. The Greeks traced the origin of the art of healing to Apollo, and subsequently made *Æsculapius*, the son or descendant of Apollo, the god of medicine. *Machaon* and *Podalirius*, the sons of *Æsculapius*, are represented as exercising the art of surgery at the siege of Troy. The knowledge of anatomy displayed by Homer has been highly spoken of, but it does not appear that the art of the surgeon in his day was much in advance of that of the butcher. The Hippocratic collection shows a great advance in the art of surgery. It contains six surgical treatises, in which important operations are described as conducted in a mode little behind the practice of the present day. One of these at least, that on wounds of the head, belongs to the works most certainly ascribed to Hippocrates (flourished about 400 B.C.). Trepanning for lesions of the head attended with compression, the extirpation of polypi from the nose by some of the principal methods still in use, treatment of ulcers by compression, abdominal paracentesis or tapping, and cupping are among the operations described. As the circulation of the blood was not understood, bleeding was used topically. Amputation was forbidden by oath to the pupils of Hippocrates. This seems to have been in accordance with the religious notions of the Greeks, but Littré considers all the explanations which have been given of this prohibition, and the qualified interpretations which have been put on it, as unsatisfactory. The anatomical knowledge of the Greeks was probably as far advanced as their religious prejudices, which limited anatomical examination to the bodies of inferior animals, permitted. A great advance in an anatomical direction was made by the Alexandrian school (say about 300 B.C.), among whom may be mentioned Hierophilus, Erasistratus, Philoxenus, Gorgias, Hero, the two Apollonii, and Ammonius the lithotomist. The first who cultivated medicine at Rome were Greek slaves, who were permitted to establish public baths, and it is from this time that the association of medicine, and especially of surgery, with bath-keepers and barbers is to be reckoned. Medicine was at length studied as a special science from the works of Hippocrates and the Alexandrian school, and among its professors who advanced the

art of surgery were Archagathus (200 B.C.), who acquired the surname of the executioner from his frequent use of the knife; *Asclepiades*, to whom is attributed the origin of laryngotomy; and *Themison*, the first who made known the use of leeches. A greater name than these is that of *Celsus*, called the Latin Hippocrates, because he has summarised the knowledge of his day, and the medical Cicerone, because of the elegance of his style. He flourished about the beginning of the Christian era. His works indicate a great advance in surgery since the time of Hippocrates. He mentions autoplasmic operations (or such operations as the *rhinoplastic operation*, which see) and the treatment of hernias, and he advises a method of amputation which is still occasionally employed. He describes the operation of cutting the perineum by a transversal and curvilinear incision, and treats of the ligature and compression of vessels. *Celsus* in a celebrated passage describes the qualities of the model surgeon. 'He should be young, or at least very little advanced in age, his hand firm, sure, and never tremulous; he should be as dexterous with the left hand as with the right; his eyesight should be clear and penetrating; he should be intrepid; and his sensibility should be such that, determined to cure his patient, he should be unmoved by his cries, and should neither hasten the operation nor cut less than he ought, but proceed as if the complaints of the patient made no impression on him.' After *Celsus* appeared *Thessalus* of Tralles, whose precepts relative to the treatment of wounds are worthy of a modern author; *Dioscorides*, who treats of the effects of the bites of enraged and venomous animals; *Aretæus*, who lived in the first century, and is said to have first used blisters (of cantharides); and *Archigenes* and *Rufus*, who practised the tying and compressing of vessels, which had been briefly indicated by *Celsus*. *Archigenes* is supposed to have been the first to apply a circular ligature. *Soranus* perfected the diagnosis and treatment of different fractures, particularly those of the vertebrae. *Hellodorus* objected to amputation at a single stroke of the knife, and indicated the method of amputating with flaps. *Galen* (died 200 A.D.) did much for medicine, but little for surgery. He rendered its treatment more methodical, however, and showed the advantages derived from the study of anatomy, but he obscured it with a multitude of etiological hypotheses and subtle distinctions, and overloaded it with the prescription of medicines. His anatomical knowledge enabled him to prognosticate with a certainty previously unknown the course of the maladies resulting from wounds and lesions, and he treated bandages and the means of arresting arterial hæmorrhages better than his predecessors. During the decline of science which followed the time of *Galen* surgery suffered like other branches of knowledge. *Philagrius* alone deserves mention for the operation for aneurism which he is said to have described. Two compilers, *Oribasius* and *Ætius*, the former two centuries after *Galen*, the latter of the sixth century, sum up the knowledge of their day. *Paul of Ægina*, a practitioner of the seventh century, may be looked on as the last representative of the Greco-Roman school.

After the conquest of Egypt the Arabs were initiated into medicine and surgery by the translation of the books of the Greeks. As their religion forbade dissection they were compelled to build entirely on the knowledge of anatomy derived from the Greeks. The practice of surgery was therefore for the most part abandoned to unlettered men. *Avenzoar*, about the end of the twelfth century, is the only African practitioner who combined the theoretical studies of medicine with the practice of sur-

gery. Among the Asiatic Arabs the only devoted student of surgery who has left any record of his art is Albucasis, who flourished at the beginning of the twelfth century.

The medical art in Europe shared in the total eclipse of science which ensued on the decline of the Roman Empire. It fell entirely into the hands of the monks, who had a monopoly of education, and when in 1163 the Council of Tours prohibited the clergy, on the plea of abhorrence of bloodshed, from performing any operation involving the shedding of blood, surgery was banished from the universities, which were entirely under the control of the church; and being left to the uneducated laity became incorporated with the trade of the barber. It was again reduced to the simplest operations, chiefly that of letting blood, as still represented in the well-known barber's sign-pole. The earliest revival of science arose from the contact of the Europeans with the eastern nations, particularly the Arabs, who were more civilized than themselves, through the Crusades. Adventurous youth went to study in the Arabian universities. Jewish physicians were attracted to European courts by the patronage of the monarchs, and already, before the close of the eleventh century, Salerno in Italy, just recovered from the Saracens, had acquired celebrity for a school of medicine in which all the teachers were laymen. As was natural in the first instance the new school devoted itself entirely to the resuscitation of ancient learning, without venturing upon original research, and in this useful undertaking it laid the foundation for modern European science. But in science as well as in literature the veneration for ancient learning which grew up on its revival in a comparatively barbarous age was unfortunately carried to the extent of a servile superstition, and in no department of science was the slavish deference to authority carried farther, in none was it productive of more baneful effects than in that of medicine. Yet here and there new observations continued to be made, and progress, though long trammelled by a rigid adherence to fixed theories, was never wholly arrested by them. The school of Salerno acquired the right to confer the degrees of master and doctor. Constantine, surnamed the African, under whom it first attained celebrity, and who died in 1087, was a learned compiler, and first made known to Western Europe the works of the Greek, Latin, and Arabian physicians. His successors and followers acclimatized the surgery of Albucasis in the different countries of Europe, and thus laid a foundation upon which new investigations and discoveries began to be made. Among the surgeons of reputation produced by the Salernian school may be mentioned Roger of Parma and his disciple Roland, who made great use of cataplasms and other topical emollients. Roger recommended the use of the sponge for scrofula and goitres. Bruno and Theodoric followed an opposite practice, and treated tumours, wounds, and ulcers indifferently with topical desiccatives and heating applications. The former founded on the aphorism derived from Hippocrates *Laxi tumores boni; crudi vero mali*, the other on that of Galen, *siccum sano propinquius, humidum vero non sano*. Thus we have an early example of those rival schools resulting from the blind application of maxims without reference to experience, which proved so long the ridicule of science, and in a later age afforded a fertile topic for the satire of Molière. Guglielmo of Saliceto (died in 1280), a professor at Verona, has left in his work entitled *Cirurgia* a monument of skill and knowledge remarkable for his day. He treats of the cure of wounds of the brain, of the œsophagus divided by a razor, of the intestines laid open by the blow of a knife. Lanfranco, the most

celebrated of his pupils (died 1800), proceeded to Paris and made the friendship of Pitard, the physician of Louis IX., who had accompanied the king on his foreign expeditions, and who drew up and procured the royal approval of the statutes on which was founded the College of Surgeons. Guy de Chauliac, the first great surgeon of France, belongs to the latter half of the fourteenth century. He practised at Lyons, and afterwards at Avignon, and was physician successively to the three popes, Clement VI., Innocent VI., and Urban V. He left an account of the plague which ravaged Europe in 1348. His great work on surgery is an admirable compilation of the surgical knowledge of the day, of which he was completely master, and the names of Albucasis, Bruno, Lanfranco, Roger, and Guglielmo are frequently cited in it. It is divided into seven books, with a preface which contains a summary of the medical practice of the day. With the Renaissance came a return to the study of nature. Among those who led the way in this important reform special mention is due to two Italian physicians, Antonio Bienivieni, a Florentine (died in 1502), who attached himself chiefly to pathology; and Alessandro Benedetti (alive in 1511), who gave public demonstrations of anatomy at Verona and Venice. Berengario de Carpi, a great surgeon and anatomist, held a chair at Bologna from 1502 to 1507. He boasted having dissected more than 100 dead bodies, and he made important discoveries. Another Bolognese professor, Maggi, who died in 1552, made important observations leading to the correction of errors in the treatment of gunshot wounds. Andreas Vesalius, a Belgian physician, born 1514, died 1564, after studying in Italy became at twenty a surgeon in the armies of Charles V. He was called to the chair of Padua in 1537. He returned home in 1543, and was appointed surgeon in the army operating in Guelders. On the death of the emperor he followed Philip II. to Spain, where for some unknown cause he was, according to non-contemporary accounts, condemned to death by the Inquisition, a sentence commuted by the king into an expiatory journey into the Holy Land. He was called home from this voyage by the offer of a chair at Padua, but died in the island of Zante on his return. Vesalius is regarded as the father of modern anatomy. In order to pursue his studies he was compelled, at great risk, to steal dead bodies by night from the cemeteries. He found errors in Galen, arising from his having dissected animals (apes) instead of human bodies, and he made enemies among his contemporaries, whose prejudices he shocked by exposing these errors. Vesalius's great anatomical work, *De Humani Corporis Fabrica libri septem*, was first published at Venice in 1543; at Basel by Oporini, with engravings in wood by Calcar, pupil of Titian. Vesalius laments in it the decline into which surgery had fallen in the middle ages, and advocates its re-union with medicine. It is rarely, he says, that medicine does not require the aid of all its three branches, and he recommends physicians to practise surgery themselves instead of committing it to inferior hands. Vesalius prepared the way for Ambroise Paré, who did for surgery what he had done for anatomy. Originally apprenticed to a barber, he came to Paris, obtained the best surgical education of his day, became a member of the School of Surgeons, and was successively surgeon in ordinary to Henry II., Charles IX., and Henry III. He gave method and precision to the operations of surgery, and introduced or perfected various instruments, particularly that of the trepan, on which he placed a cap to prevent it from going too deep into the cranium. His works, which include a general treatise on surgery as well as a special treatise on wounds, in both

of which he introduced numerous improvements, made him many enemies and persecutors. Two books of his on surgery were suppressed by the faculty of medicine, because he was supposed to have spoken disrespectfully in them of the generation of man. Paré's works have been translated into English. Paracelsus (Hohenheim), a native of the canton of Schwytz, who professed medicine at Basel in 1526-27, is another of the great names of the Renaissance period. He determined, after an extensive educational tour, in which he formed the conviction of the worthlessness of the theories followed by the medical practitioners of his day, upon a thorough reform. He served in Italy, Belgium, and Denmark as a military surgeon. When called as professor to Basel he taught in German, because he held that medicine ought not to be a secret art, and publicly burned the works of Galen and Avicenna, the celebrated Arab physician, to show his contempt for the venerated authority of antiquity. By these and other measures he offended the authorities, and was obliged to leave Basel. He visited various countries, and made numerous enemies by his violent denunciations of the ignorance and prejudice of medical practitioners, and their influence procured from the imperial censorship a prohibition of the publication of his works, which were afterwards mixed up with the lucubrations of pretended disciples, who attributed to him a belief in magic and other views which his genuine works repudiate. These are distinguished for scientific method and sound observations. The justice of his views is especially remarkable in the principles he inculcates on the natural healing of wounds and the function of art in assisting nature; on the strict union of medicine and surgery, and in founding medicine upon the study of chemistry. He made excessive use of ointments, balsams, and plasters, but he varied his prescriptions according to the nature of the case, and some of them, as that of arsenical preparations for ulcers and cancers, were valuable discoveries. Felix Wurtz, a native of Zurich, who exercised his art at Basel, also deserves mention as one of the most famous surgeons of the sixteenth century. His *Practice of Surgery*, which appeared at Basel in 1576, after his death, contains five books, of which three are on wounds, on his masterly treatment of which his reputation depends. The successors of Paré made worthy of note are Pigras, his disciple, who made an abridgment of his master's work much inferior in style to the original; Guillemeau, whose special study was ophthalmia; Pineau, a skilful surgeon and lithotomist; Jacques Démarque, one of the first authors who wrote on bandages. In Italy Falloppio, Colombo, Casserio, and Fabricio d'Aquapendente made useful observations and discoveries; in Germany Fabricius of Hilden embraced in his works a complete course of clinical surgery, and invented instruments for the extraction of foreign bodies from the œsophagus, the ear, and the urethra, which are still in use. In England Harvey, the discoverer of the circulation of the blood, lectured on surgery, but a genuine school of surgery was first founded by Richard Wiseman, who has been called the Paré of England. His collected works in two vols. 8vo were published in 1676. The company of Barber Surgeons incorporated by Edward IV. in 1461 only gave place to a separate corporation of surgeons in 1745; the Royal College of Physicians and the Royal College of Surgeons are still separate incorporations. See the separate articles on these bodies, and MEDICAL ACT.

In France in the meantime the profession of surgery began to decline. The medical faculty, jealous of the *éclect* which the followers of Paré had thrown

around it, procured the exclusion of the faculty of surgery from the university, and accomplished its forced re-union with the corporation of barbers. Surgery was thus nearly extinguished in France for more than half a century. Two French surgeons, Bienaise and Roberdeau, taught the higher branches of their profession at their own expense; and Louis XIV. in 1671 opened to surgeons the chair of surgery in the Jardin des Plantes, hitherto confided to the physicians of the schools of Paris and Montpellier; the Royal Academy of Surgery was founded in 1731, and soon produced a school of surgeons so eminent as to take the lead of their profession in Europe, but the proscription of surgery at the university was not raised till 1743, when the barbers were separated from the surgeons. At the revolution the Faculties of Physicians and Surgeons were united, and have since continued to be so. Among the many eminent surgeons who began at this time to render the French school so distinguished we may mention J. L. Petit, Desault, Mareschal, La Peyronie, La Martinière, Quesney, Morand, and Louis. England had also, since the time of Wiseman, acquired a flourishing school of surgery. Among many eminent names those of Cowper, Cheselden, Alexander Monro, primus and secundus, Samuel Sharp, Charles White, Percival Pott, Bromfield, and John and William Hunter. Pre-eminent among these are Percival Pott and John Hunter, the latter, though without a regular professional education, the most eminent surgeon and physiologist of his day, equally sagacious and indefatigable in investigating the causes of all scientific phenomena, especially those more directly bearing on his profession, his discoveries and collected observations in which are invaluable. The nineteenth century will ever be conspicuous in the annals of surgery as that in which the inestimable boon of anæsthetics was conferred upon mankind, by which not only has pain in surgery been abolished, but the extent of its operative department immensely enlarged. Of no less importance has been the discovery of the relation of micro-organisms to putrefaction and to infectious diseases, and the consequent introduction of the antiseptic method of treating wounds. A scarcely less noticeable feature of this epoch has been the application of the rules of hygiene to the construction and management of hospitals, by which the general health of the patients has been much benefited and the mortality reduced. The operative skill of the surgeon has kept pace with the increased precision of physiological knowledge, and surgical operations are now performed which not long ago would have been deemed certain death to the patient. Diseased conditions in the cranium, the thoracic cavity, the abdomen, and the uterus are among those now treated with special boldness and success. Among eminent surgeons of the nineteenth century we may mention Astley Cooper, Abernethy, Brodie, Simpson, Syme, and Lister in Britain; Dupuytren, Dubois, and Bichat in France; and Gräfe, Langenbeck, and Dieffenbach in Germany.

**SURINAM.** See **GUIANA (DUTCH).**

**SURINAM TOAD.** See **PIPA.**

**SURMULLET, or STRIPED RED MULLET.** See **MULLET.**

**SURNAMES.** See **NAMES (PERSONAL).**

**SURPLICE** (Latin, *super-pellicium*), a vestment of linen or muslin worn by priests, deacons, and choristers in the Church of England and the Roman Catholic Church during the performance of religious services. It is supposed by some to be identical with the garment used by Roman Catholic priests in performing mass and called the *alb*. The surplice is usually worn by priests and deacons of the English Church during prayers and devotional services,

but not when preaching. Many of the Anglican clergy, however, now use it when preaching, but this is considered to savour of ritualism.

**SURREY**, a county of England, bounded north by the Thames, separating it from Middlesex; east by Kent; south by Sussex; west by Hampshire; and north-west by Berkshire and a small corner of Buckinghamshire; area, 461,791 acres. The surface is in general not elevated, but undulating and diversified, presenting much pleasing scenery. Near the centre a range of hills stretches completely across the county. This range, called the North Downs, slopes down gently on its north, but is rugged, precipitous, and often of romantic appearance on its south side. The highest point in the direct line of the range is Botley Hill, above Titsey, 880 feet; but the highest point in the county, and indeed in this part of England, occurs about 8 miles south of Dorking, in Leith Hill, which is 993 feet. Along the south border a tract called the Weald of Surrey unites with the Wealds of Kent and Sussex in forming a flat and very extensive plain, occasionally broken by low hills. The north-west is the least inviting part of the county, consisting for the most part of heath and moorland waste. This portion of the county belongs entirely to the geological formation known by the name of the London clay; immediately south and east of it a tract of nearly equal extent is occupied by the plastic clay, which is succeeded on the south by the chalk-formation, of which the Downs above described are composed. The southern part of the county belongs to the wealden formation. The whole of the drainage is received by the Thames, except a small portion in the south-west, conveyed to the English Channel by the Arun, and another small portion in the south-east, received by the Medway. After the Thames the only streams of importance are its tributaries, the Mole—which, entering Surrey on the south-east, winds through a beautiful valley for about 42 miles in a N.N.W. direction, but is nowhere navigable—and the Wey, which flows from north-west to north-east, and not only becomes navigable at Godalming, but forms the principal feeder of the Basingstoke Canal. The only other canal is the Grand Surrey, which, cut from the Thames at Rotherhithe to Deptford, and thence to Camberwell, is very short but of considerable importance, containing in particular an extensive basin, in connection with the navigation of the Thames. The other principal means of communication are the South-Eastern, the South-Western, the London and Brighton, the London, Chatham, and Dover Railways, with numerous branches, particularly near the metropolis. The soils include all the principal varieties of plastic and alluvial clays, rich vegetable loam, calcareous earth, and almost barren heath. On the first of these the principal crops are wheat and beans. Much of the alluvium, particularly in the vicinity of the metropolis, is occupied by orchards and kitchen-gardens, and whole farms are devoted in the same locality to the raising of medical and aromatic plants, as chamomile, wormwood, anise-seed, peppermint, and lavender. The loamy soils grow excellent barley, oats, and pease; there, too, root crops, more especially carrots and parsnips, are extensively grown. The calcareous soils are chiefly remarkable for their excellent hops, among which those of Farnham deserve special notice; and for their valuable crops of clover. The quantity of grazing land is not extensive: the domestic animals are usually of the ordinary improved breeds. Of the total area of the county more than one-ninth is under woods and plantations, about one-eighth is under corn crops (a considerably smaller area than formerly was so occupied), about one-thirteenth is under green crops, and one-

third is permanent pasture. The manufactures are not of much importance, consisting chiefly of woollen goods and hosiery at Godalming; gunpowder at Malden; delft and stoneware at Mortlake; calicoes, with large bleaching and printing works, in the parishes of Mitcham and Croydon; oil, paper, snuff, sheet-iron, &c., for which there are numerous mills, partly on the Mole and partly on the Wandle; and numerous articles made in Southwark, principally in connection with the trade of the port of London. Of this trade the part of the county immediately bordering the Thames has a considerable share. The vicinity of the metropolis, and the many beautiful sites which it affords, have caused many parts of Surrey to be studded over with mansions and villas. The county contains Southwark, Lambeth, and other southern suburbs of London, and the municipal boroughs of Godalming, Guildford, Kingston-upon-Thames, and Reigate. For parliamentary purposes it is divided into six districts, each of which returns one member to Parliament. The borough of Lambeth returns four members, Southwark three. Part of Greenwich is also in Surrey. Pop. (1881), 1,436,899; (1891), 1,731,343; (1901), 2,008,923.

**SURREY.** See HOWARD (FAMILY OF).

**SURROGATE**, one who is substituted or appointed in the room of another; as the bishop or chancellor's surrogate.

**SURTURBRAND**, fossil wood, impregnated more or less with bitumen, found in great abundance in Iceland. A bed of it extends nearly through the whole of the north-western part of the island. It is, in fact, a subterranean forest, impregnated with bituminous sap, and compressed by the weight of the superincumbent rocks. Branches and leaves are pressed together in a compact mass; but the fibres of each may be distinctly traced. The surturbrand is used by the Icelanders chiefly in their smithies, and in small quantities. It is sometimes so little mineralized as to be employed for timber.

**SURVEYING**, in a general sense, denotes the art of measuring the angular and linear distances of objects, so as to be able to delineate their several positions on paper, and to ascertain the superficial area, or space between them. It is a branch of applied mathematics, and supposes a good knowledge of arithmetic and geometry. It is of two kinds, land surveying and marine surveying, the former having generally in view the measure or contents of certain tracts of land, and the latter the position of beacons, towers, shoals, coasts, &c. Those extensive operations which have for their object the determination of the latitude and longitude of places, and the length of terrestrial arcs in different latitudes, also fall under the general term *surveying*, though they are frequently called *trigonometrical surveys*, or *geodetic operations*, and the science itself *geodesy*. Land surveying consists of three distinct operations: 1, the measuring of the several lines and angles; 2, projecting or laying down the same on paper, so as to form a correct map of an estate or country; 3, the computation of the superficial contents, as found by the preceding operation. Various instruments are used for the purpose of taking the dimensions, the most indispensable of which is the chain commonly called *Gunter's chain*, which is 66 feet long, and is divided into 100 links, each 7·92 inches: 10 of these square chains, or 100,000 square links, is 1 acre. This is used for taking the linear dimensions when the area of the land is required; but when only the position of objects is to be determined, a chain of 50 or 100 feet is more commonly used. For accurate surveying proper instruments for measuring angles are required. The best instrument for this purpose is the theodolite. The surveyor's

cross, or cross-staff, is likewise very convenient for raising perpendiculars. See GEODESY and ORDNANCE SURVEY.

**SUSA**, an ancient city of Persia, the capital of the province of Susiana and the winter residence of the Persian kings, was situated on the east bank of the river Choaspes (modern Kherkhah). It is said to have derived its name from the lilies which abounded in the plain in which it was situated, *susan* or *shusan* being the Persian for lily. It was quadrangular in form; according to some 120, according to others 200 stadia in circuit; with a strongly-fortified citadel, containing the palace and treasury of the Persian kings. The Greeks gave this citadel the title of Memnonium, from whence arose a tradition that the city was founded by Tithonus, the father of Memnon. Susa is the Shushan of the book of Daniel, where it is mentioned as situated on the banks of the river Ulai or Eulæus. This stream, according to Pliny, surrounded the citadel of Susa. The plain is watered by numerous rivers, several of which flowed in the immediate vicinity of the city. The plain of Susa is covered with extensive mounds, in which fragments of brick and pottery with cuneiform inscriptions are found. Susa was taken by Assur-bani-pal in the seventh century B.C., and we afterwards find it mentioned as a Babylonian city. Cyrus brought it under Persian rule, and it was made the capital of the Persian empire. Alexander the Great took it in the course of his conquests, but under him it gradually lost its importance. See works by Dieulafoy and Billerbeck.

**SUSANNA**, Book or, is one of the additions to the book of Daniel found in the Greek versions of Theodotion and the Seventy. They have not been found in any Hebrew original, and are generally rejected and ridiculed by the Jews; but they are accepted as canonical by the Roman Catholics. In the stories of Bel and the Dragon, and Susanna, Daniel is said to give utterance to Greek puns, or plays on words depending on Greek derivations. Susanna forms the thirteenth chapter of Daniel in the Septuagint version. The story is supposed to have some foundation in fact, and to have been narrated with a moral object.

**SUSPENSION-BRIDGE**. See BRIDGE.

**SUSQUEHANNA**, a river of the United States, formed by two branches, an eastern or northern and a western, which unite at Northumberland in Pennsylvania. The eastern branch, which is considered the main stream, issues from Lake Otsego in New York, and has a length of about 250 miles. The western branch rises in the western slope of the Alleghanies, and flows very circuitously E.S.E. for about 200 miles. The united stream flows south and south-east, passing Harrisburg and Columbia, enters Maryland, and after a course of about 150 miles falls into the northern extremity of Chesapeake Bay at Port Deposit. The navigation is much obstructed by rapids, but the obstructions have been greatly overcome by cutting canals.

**SUSSEX**, a southern maritime county of England, bounded on the north by Surrey, north and north-east by Kent, south-east and south by the English Channel, and west and north-west by Hants; area, 931,899 acres. The rivers are small and of no importance, and the great physical feature of the county is the range of chalk hills known as the South Downs, which terminate in the bold promontory of Beachy Head. They are used for sheep pasture, and the breed for which the county is famed is known as the 'South-downs'. The principal means of communication are the London, Brighton, and South-Coast Railway, and in the eastern part the South-Eastern Railway. The first-named company has excellent

fast steamers running daily between Newhaven and Dieppe; the passage (64 miles) is frequently accomplished in 3½ to 3¾ hours. The low land along the coast is remarkable for its fertility, raising heavy crops of grain, and still more valuable crops of hay, particularly on the marsh-lands, which, after being cut, are pastured, and feed off large numbers of heavy cattle. The Downs are chiefly pastoral, and where arable consist of a thin flinty soil, on which barley is the most profitable crop. The Weald (originally so-called because covered with one dense forest), forming the larger part of the whole surface, consists generally of sandy or tenacious clays of a very indifferent description. The eastern part of the county borders on the hop districts of Kent, and successfully pursues the same mode of cultivation. Of the total area about 670,000 acres are under crops, rotation grasses, or permanent pasture. Corn crops, chiefly oats and wheat, are grown on more than 135,000 acres; green crops, chiefly turnips, mangold, and cabbages, on about 60,000; and the area in permanent pasture is nearly 390,000 acres. About 122,000 acres are covered with woods, which abound principally in the Weald, and in the Forest Ridge in the north-east, where are the Forest of Ashdown (14,000 acres) and the Forest of St. Leonards (10,000 acres). Among the mineral products may be mentioned 'Sussex' marble, a kind of limestone containing fresh-water shells, which is worked to some extent in the neighbourhood of Petworth, and admits of being cut and polished. Ironstone also is abundant, and in early times, when wood only was used for smelting, furnished one of the principal sources of the British iron manufacture, though it has been long abandoned. The manufactures of the county are insignificant. Sussex was thoroughly brought under the Roman rule. It subsequently formed part of the kingdom of Suthseaxe, or the South Saxons (whence its name), founded by Ella in the fifth century. According to Prof. E. A. Freeman 'the county of Sussex, which contains the hill of Senlac (popularly called Battle) and the hill of Lewes, has witnessed greater events than any shire of England'. The county is rich in archaeological remains, among which may be mentioned the castles of Pevensey, Bodiham, Hastings, Arundel, Bramber, and Hurstmonceux, the ancient boroughs of Rye and Winchelsea, &c. The mean temperature of the year is a little over 51° Fahr., or more than one degree above the mean temperature of London. In consequence of this, Sussex has developed the feature for which it is now distinguished amongst English shires, namely, the health resorts or fashionable watering or bathing places which are planted along its coast from end to end. The most famous of these localities is Brighton, and next Hastings, Eastbourne, and Worthing; whilst the minor places are Seaford, Littlehampton, and Bognor. The six parl. divisions of Sussex are Chichester, Eastbourne, East Grinstead, Horsham, Lewes, and Rye. Brighton returns two members to parliament and Hastings one. The municipal boroughs are Lewes, Brighton, Hastings, Eastbourne, Chichester, Arundel, Rye, and Worthing. Pop. (1881), 490,505; (1891), 550,446; (1901), 605,052.

**SUSTENTATION FUND**. See FREE CHURCH OF SCOTLAND.

**SUSUK**, Soosook, Soosoo (*Platanista Gangetica*), a species of Cetacea or Whales, represented by a single form, the Gangetic Dolphin, which inhabits the navigable parts of the Ganges, and occurs in the numerous branches which intersect the delta of the river. It represents a fluviatile or river-inhabiting species of Cetacean—these habits presenting a marked contrast to those of the other members of the order Cetacea.

Another and allied form—the *Inia Bolivensis*—inhabits the Amazon of South America. The beak in the Soosook is very prominent, being elongated and of slender and compressed shape. The teeth are very numerous—numbering about 120—and are of small size. The colour is a grayish-black on the back, and white on the under parts. The eye is very small. The total length of this animal is about 4 or 5 feet. No dorsal fin is developed. In habits the Soosook exhibits a natural inactivity, although when occasion requires it can swim with great swiftness.

SUTHERLAND, a maritime county in the north of Scotland, bounded on the north by the Pentland Firth, west by the Minch, south by the county of Ross, east by the German Ocean, and north-east by the county of Caithness. It is in the shape of an irregular square, about 50 miles each way, from east to west and from north to south, and along with the greater part of Ross and the whole of Caithness forms an extensive peninsula, the isthmus of which may be conceived as stretching across the island between the heads of the Beaulie Firth and Loch Carron; area, 1,345,480 acres. In addition to the mainland, it includes a number of small adjacent islands on its northern and western sides. On these sides the coast is remarkable for the loftiness and boldness of its precipices, and its deep indentations by numerous lochs or arms of the sea. In these respects the east coast presents a striking contrast, being generally flat and continuous, with sandy shores, except in the north-east, where the headland of Ord, common to this county and Caithness, juts out majestically into the German Ocean. The interior consists of a succession of lofty and rugged mountains, rising in Ben More of Assynt to 3273 feet, and separated from each other sometimes by moorland plateaus, and sometimes by wild romantic valleys, either embosoming extensive lakes or traversed by mountain streams. The watershed of the county is formed by a range stretching almost centrally across it from east to west, and then north to south, at no great distance from the west coast. This watershed sends the drainage in three directions—north, west, and east; but the streams, though valuable for their salmon-fishings, are not otherwise deserving of notice. The lakes, which sometimes stretch in chains, are both large and numerous. Among others are Loch Shin in the south, stretching south-east to north-west for about 16 miles; Loch Naver, near the centre of the county; Loch Hope, in the north; and Loch Assynt, at a short distance from the west coast. All these lakes form long and comparatively narrow expanses, which, when their extremities are not seen, give them the appearance of majestic rivers. The rock most largely developed in the county is gneiss, which occupies at least four-fifths of the whole surface. Other rocks, which occur chiefly in patches, are granite, mica-slate, and old red sandstone. The last occurs both in the north-west towards Cape Wrath, and in the south-east along the Dornoch Firth. In the last portion it is succeeded by one of the most remarkable geological formations of Scotland, the Brora coal-field; unfortunately, however, more interesting to the geologist than valuable for the fuel which it yields. In connection with this coal-field are strata of lias and oolite, found in no other part of Scotland except a small patch to the west of the town of Campbelltown in Kintyre, and a few patches of the Western Isles. The greater part of the county is fitted only for grazing, but even on the stock-farms large quantities of excellent turnips are grown, and eaten by sheep; and in some of the lower valleys, and more especially on the east coast, oats and barley are successfully cultivated. Potatoes succeed well on the arable land of most

districts. Natural woods of birch, alder, and even oak are not uncommon; and large plantations of fir, larch, and other trees have recently been formed. Over 900,000 acres are mountain and heath used for grazing, about 20,000 acres are under woods and plantations, and about 82,000 acres are under crops and grass. Corn crops, mostly oats, are grown on some 9000 acres; green crops, mostly turnips and potatoes, occupy more than 4000 acres; and the area in permanent pasture is about 10,000 acres. Large pieces of waste land have been brought into cultivation by the Duke of Sutherland at Lairg, near the foot of Loch Shin. Game of all kinds, including deer, is abundant, and on most estates now forms an important item in the rental. The county sends a member to Parliament. Pop. (1891), 21,940; (1901), 21,289.

SUTLEJ, or SATLEJ (ancient, *Hesidrus*), one of the 'five rivers' of the Panjab, of which it forms the eastern boundary. It has its sources in Tibet between lon. 81° and 82° E., a little to the east of Lake Ravana-Hrads or Rakas-tal, which it enters (apparently from Lake Manasarowar), and from which it subsequently issues at an elevation of about 15,000 feet. On leaving the lake it flows north-west to Nako, about 150 miles, where it suddenly turns S.S.W., passes through the Himalaya range, and continuing its south-western direction, flows along the eastern limit of the Panjab till it joins the united stream of the Jhilm, Chenab, and Ravi, thus forming the Panjad, which enters the Indus at Mithankot. In the north-east of the Panjab it receives the Bias. Its entire length is about 900 miles. The scenery along the upper course of the Sutlej is often at once fearful and sublime. The river itself is there a raging torrent, falling in several places 100 feet or 150 feet per mile. Its lower course is navigable.

SUTTEE (Sanskrit, *sati*, an excellent wife), a term applied by the English to the self-immolation of Indian widows on the funeral pile of their deceased husbands. The origin of this practice is of considerable antiquity, but it is not enjoined by the laws of the great legislator Manu, nor is it based on the Vedas. This practice was abolished by Lord Bentinck, governor-general of India, in December, 1829, and may now be said to be extinct, though perhaps rare cases still occur. Until then the British government had permitted it, provided the act was perfectly voluntary (which the religion of Brahma also prescribes), and if notice of such resolution had been previously given to a magistrate, who was required to see that the suttee was public, and that all the requisitions of the law were fulfilled. The ceremonies of a suttee were various, and lasted from a quarter of an hour to two hours. Sometimes the widow was placed in a cavity prepared under the corpse of the husband; sometimes she was laid by the body, embracing it. If the husband died at a distance from home, anything which belonged to the deceased—his garments, slippers, walking-staff—might be substituted for the corpse.

SUVALKI, a town of Russian Poland, capital of the government of same name, 152 miles north-east of Warsaw. It is well built, has a large market-place, two churches, and handsome buildings in which the courts and public offices are held. Pop. (1893) 22,646. The government contains an area of 4651 square miles, with a pop. (in 1897) of 604,945.

SUWAROF-RYMNIKSKI, PETER ALEXIS VASILVICH (his name is also spelled *Suvorof*, *Suvarrow*, &c.), Count of, Prince Italinski, field-marshal and generalissimo of the Russian armies, one of the most distinguished generals of the eighteenth century. The time and place of his birth are uncertain, the former being placed by different authorities in

Finland, at Suskir in the Ukraine, and at Moscow; the latter in 1729 or 1730. His father, an officer, placed him in the military academy at Petersburg; and in his seventeenth year Suwarof entered the service as a common soldier, and gave proofs of his courage in the war against Sweden. In 1754 he became lieutenant, and after distinguishing himself in the Seven Years' war, received the command of a regiment in 1763. In 1768 he obtained the rank of brigadier-general, and served several campaigns in Poland, receiving in reward for his courage and conduct the crosses of three Russian orders of knighthood. In 1773 he was appointed to the command of a division of the troops under Count Romanzoff, and completely defeated a portion of the Turkish army at Turtukai, killing several of the enemy with his own hand. Crossing the Danube, he afterwards, in conjunction with the force under Kamenakoi, routed the army of the *reis effendi* with great slaughter, and the capture of all his artillery. In 1783 he reduced the Kuban Tatars under the Russian yoke. In 1787, being chief in command, he was intrusted with the defence of Kinburn, then attacked by the Turkish forces both by sea and land, and after an obstinate siege succeeded in repulsing his assailants with considerable loss. At Oczakow and Fokshani (at the former of which places he received a severe wound) his daring valour was equally displayed; and in the September of 1789 the Austrian troops under the Prince of Saxe-Coburg, being surrounded on the banks of the Rymnik by 200,000 Turks, owed their preservation to his timely arrival with 10,000 Russians, who not only rescued them from a destruction that appeared inevitable, but occasioned the utter overthrow of the enemy. To this victory he was indebted for the first of his above-named titles, and the dignity of a count of both empires. The next, and perhaps the most sanguinary of his actions, was the storming of Ismail in 1790. This strongly-fortified town had resisted all attempts to reduce it for a period of seven months, when Suwarof received peremptory orders from Prince Potemkin to take it without delay, and pledged himself to execute the task assigned him in three days. Of the sacking of the place on the third, and the indiscriminate massacre of 40,000 of its inhabitants of all ages and both sexes, the writers of the time give most revolting reports. The announcement of his bloody triumph was made by the general, who affected a Spartan brevity in his despatches, in the words, 'Glory to God! Ismail is ours.' Peace being proclaimed with Turkey, the empress (see CATHERINE II.) had leisure to mature her designs against the devoted Kingdom of Poland, and Suwarof was selected as a fit instrument to carry them into execution. He marched accordingly at the head of his troops to Warsaw, destroying about 20,000 Poles in his way, and ended a campaign of which the partition of the country was the result. On this occasion he received a field-marshal's baton and an estate in the dominions which he had contributed to annex to the Russian crown. The last and most celebrated of his actions was his campaign in Italy in 1799, when his courage and genius for a while repaired the disasters of the allied forces. Paul gave him the command of the Russian forces destined to act with the Austrians, and the Emperor of Germany created him field-marshal and commander-in-chief of the Austrian troops in Italy. He gained several brilliant victories at Piacenza, Novi, &c., and drove the French from all the towns and fortresses of Upper Italy, and was rewarded for his services with the title of Prince Italinski. But in consequence of a change in the plan of operations he passed the Alps; and the defeat of Koriakof at

Zürich, together with the failure of the expected assistance from the Austrians, obliged Suwarof to retreat from Switzerland. Paul, offended with the Austrian court, now recalled the prince in spite of his remonstrances, and preparations were made for his triumphal entry into St. Petersburg. Meanwhile Suwarof, having evaded an imperial order directing the generalissimo to name each general in turn general of the day, by appointing Prince Bagration standing general of the day, was declared, by command of the emperor, to have deserved censure, and the preparations for his triumph were suspended. Chagrin at this disgrace hastened his death, which took place May 18, 1800, sixteen days after his arrival at St. Petersburg. Suwarof was a remarkable man. Though feeble and sickly in his youth, he had acquired a sound constitution by his simple and abstemious mode of life. He slept upon straw, and his whole wardrobe consisted of his regimental uniform and a sheepskin. He observed punctiliously all the ceremonies of his religion, and never gave the signal for battle without crossing himself and kissing the image of St. Nicholas.

SWABIA. See SUABIA.

SWALLOW (*Hirundo*), a genus of Insectivorous Birds belonging to the family Hirundinidae of the Fissirostral ('cleft-beaked') section of the order. This family is commonly made to include the well-known Swifts as well as the Swallows, the latter being classified in a special sub-family, to which the name of Hirundinidae is given. This sub-family, including several distinct genera to be presently noted, is distinguished by the fact that the bill is short, and has its sides gradually compressed towards its tip; the nostrils are of rounded form, and exist at the base of the bill; the wings are long, and their first quills are the longest; the tail is forked, and the toes are long and slender, with nails of moderate size. The genus *Hirundo*, to which the Common or Chimney Swallow (*H. rustica*) belongs, is recognized by the fact of its included members possessing the nostrils concealed by a membrane in front, and by the outer feathers of the tail being much elongated. The coloration of the Common Swallow is not generally noted by people who are otherwise perfectly familiar with its general appearance and habits. The top of the head is coloured of a reddish-chestnut hue, the back and wings being steel-blue. The tail and secondary feathers are black, a dark blue patch existing at the upper part of the chest, whilst the throat is a chestnut-brown. The beak, legs, and toes are black, and the under parts are white or grayish. The females possess the chest-patch, and also the forehead patch of red, of smaller size than the males. Occasionally white or pied varieties of these birds are produced. Their food consists entirely of insects, which, like most other Fissirostres, they pursue on the wing, and capture by means of the wide gape of the mouth and the bristles or *vibrissae* with which the gape is provided, the saliva being also of viscid nature, and assisting in the retention of the prey. Small flies of various kinds, gnats, and other insects, form the great bulk of the food, the indigestible parts of the food being rejected, as in the case of the owls, in small pellets. The flight is rapid, and is not, like that of the swifts, continuous, these birds resting occasionally. The song is weak, and is at best a mere twitter. The nest consists of a cup-shaped structure of mud or clay, for the most part built a few feet down an unused chimney, or close under the roof of some outhouse to which ready access is obtained, and lined inside with soft grasses, feathers, and other materials. Not infrequently also these birds choose some very unusual spot for the nest, such as the corners of doors, disused articles of

furniture placed outside, &c. The eggs number from four to six, and are of white colour, spotted with red. Both parents are most assiduous in their attention to their young, and feed them with the insects captured in their constant flights. Two broods are usually produced in each year, and in some cases it happens that the second brood perishes, being left destitute, through their parents obeying the migratory instinct and hurrying away. The Common Swallow occurs very generally throughout Europe, and is also known to occur as a resident in Western Africa. The migration of these birds has always attracted attention from the well-known and unvarying character of their movements. They fly southwards, at the end of October, or sometimes sooner, to winter in Africa, some finding their way to India. The generality of these birds arrive in Britain in the succeeding April, some stragglers arriving later, and a few coming before the great body of birds. They appear to fly southwards in small numbers of two or three together; and it is somewhat curious that whenever observed in their southward journey they appear much exhausted, and seem in this respect to be of inferior powers to some migratory birds whose natural powers of flight are much less than their own. They generally return to the nests they have constructed, and appear to exhibit great distress on finding their former home swept away. The Red-bellied or Barn Swallow (*H. erythrogaster*) is a familiar visitant in the United States of America. It measures about 7 inches in length, and is distinguished by having the under surface coloured of a ruddy chestnut, the female being coloured of a reddish-white below. The nest of this species is almost invariably built in barns and out-houses, and great encouragement is given to these birds to build by the farmers placing boxes and other supports in favourable situations. Another species common in America is the Red-necked Swallow. The Fairy Swallow, or Fairy Martin (*H. arid.*), as it is also named, is found in South Australia, where it arrives in August, leaving again in September or October. The nest, built in some tree, under eaves, or in rocks, is formed of mud, and is of flask-like shape. Each nest appears to be built by a number of these swallows. The Wire-tailed Swallow (*H. flifera*) of Abyssinia is so named from the presence of the two elongated tail-feathers, which, being unprovided with a web, consist of the shafts of the feathers alone, and appear as long filaments. Its general colour is a dark blue on the upper and white on the under parts, the head being of a chestnut colour. A species named the White-bellied Swallow (*H. viridis*) is also abundant in the United States. The food of this species, according to Wilson, consists chiefly of myrtle-berries, on which they grow very fat. The genus *Atticora* includes the well-known White-breasted Swallow of Australia (the *Atticora leucosternon* of naturalists), which makes its nest in the deserted burrows of animals. A very notable species of swallow, belonging to the genus *Collocalia*, is the *C. nidifica*, or Esculent Swallow, so named from its fabricating nests which are used by the Chinese in the making of soup. (See BIRDS' NEST.) Other and allied species of this genus, such as the *C. fucphaga*, the *C. troglodytes* or White-backed Swallow, and the *C. Francisca* or Gray-backed Swallow, also make these esculent nests, which are generally constructed in caverns in Java and elsewhere, and consist of a mucilaginous matter mixed with fragments of grasses and other vegetable matters. The *C. nidifica* or *esculenta*, the best-known species, is of small size, and is coloured brown above and white beneath. Like all other members of the genus *Collocalia*, the bill is small; the second wing quill is longer than

the others; the tarsal are not scaly; and the toes are short and thick. The Martins are included in the same sub-family as the Swallows, and are in very many instances denominated 'swallows' in a popular sense. The Purple Martin or Purple Swallow (*H. or Progne purpurea*) is a familiar species of North America, distinguished as a genus (*Progne*) by the strong bill with curved edges, by the moderately-sized tail, and by the tarsal being strong and scaled. The toes are slender, the outer toe being of unequal size to the other digits. Occasionally this bird has been shot in Britain. It is a general favourite in America, and everywhere takes up its abode among the habitations of men. A common practice is to hang up gourds, properly hollowed, for its convenience in nest-building; and in the more settled parts of the Union considerable expense is sometimes incurred in preparing for it a suitable residence. The eggs are six or eight in number, and of white colour. In the country it renders essential services by attacking and driving away crows, hawks, eagles, and other large birds. Its note is loud and musical. The colour of the male is a rich and deep purplish blue, with the wings and tail brownish-black; the female is more plainly attired, and has the under parts whitish, with dusky and yellowish markings. The Sand Martin or Sand Swallow (*Cotile riparia*), sometimes also named the Bank Martin, is the smallest of British swallows, and, as indicated by its names, excavates a nest in sand-banks and like situations. The nest is generally placed at the end of a cleverly-excavated gallery. It is also found in North America. It generally arrives in Britain before the Common Swallow. The House Martin (*Chelidon* or *Cotile urbana*) has a short, strong bill, and has the tarsal and toes feathered. It is of smaller size than the Common Swallow. It builds its nest under the eaves of houses, in the corners of windows, &c., the nest being a hemispherical structure of clay, with a round opening for entrance. These birds arrive in England about the middle of April, and leave for the south about October 13th or 14th. The head and upper parts are coloured deep blue, the wings and tail are black, and the upper tail-coverts pure white, as also are the under parts. The average length is 5 inches. Among the Swifts proper (which see) several forms, also popularly named 'swallows,' are included. The name of 'Sea Swallow' is given to the Tern (which see). The Wood Swallow (*Artamus sordidus*) is an Insectorial Bird, belonging to the section Dentiostres, and to the sub-family of the Dicrurinae or Dicruri, which are in turn nearly related to the Shrikes (which see).

SWALLOWING, ACT OF. See PHARYNX.

SWALLOW-TAILED BUTTERFLY AND MOTH. The former name is given to the *Papilio Machaon*, a beautiful species of Butterflies, belonging to the genus *Papilio* (which see). The Swallow-tailed Moth (*Oncopteryx sambucaria*) is a common British species of moth, belonging to the family Geometridae, and having a body of moderate size, and simple antennae in both males and females. The front wings are sharp at their tips, the hinder pair being prolonged into small tails—whence the popular name of this moth. Both sexes are winged. The wings exhibit a light yellow colour, continued into a white hue at their bases, and marked with narrow, brown streaks. The larvæ or caterpillars are of reddish-brown colour, and are usually found on the willow, lime-tree, and elder.

SWAN (*Cygnus*), a genus of Swimming Birds, belonging to the family Cygnidae of the Lamellirostral division (see LAMELLIROSTRES) of the Natatores, and distinguished as a group by the bill being of equal length with the head, and broad throughout its length;

by the cere being soft; by the front toes being strongly webbed, whilst the hinder toe is not webbed, and has no lobe or under-skin. The typical genus *Cygnus* has the cere extended to the eyes, the wings having their second and third quills longest, and the tail being short and rounded. The neck is greatly elongated, and the legs are short. The common species is the Mute or Tame Swan (*C. olor*), so named from having little or no voice. This is the only species which is permanently resident in Britain. The nest is constructed of reeds and grasses, and is generally situated near the edge of the water on some islet. The eggs are large and of a greenish white colour, and number six or seven. The young (or 'cygnets') when hatched, and for some time afterwards, are of a light bluish-gray colour. Both parents are very jealous in their care of their young. The food consists of vegetable matters chiefly, but it also includes the smaller fishes, worms, &c., and there appears little doubt that fish-spawn forms a dainty morsel to these birds, which thus destroy large quantities of valuable material. The Swan has, from a very early date, been specially protected by both legal and regal interference. In Henry VII.'s reign the theft of a swan's egg was deemed an offence punishable by a year's imprisonment; and the theft of a swan itself was very severely punished. Swans themselves, at a prior date, were declared to be exclusively 'royal' or 'king's' property; and no subject was entitled to hold possession of these birds, save under special favour from the sovereign. To such subjects as possessed the permission to keep swans a special or 'swan' mark was attached, and this mark was cut on the bill of the birds as a distinctive badge of ownership. The process of marking is known as 'swan-upping' or 'hopping,' and the ceremony in the Thames on the part of the crown and of the Dyers' and Vintners' companies takes place on the first Monday in August. The crown mark consists of five diamonds; that of the University of Oxford of an arrangement of crosses; Cambridge has three buckles; whilst the Vintners' Company mark these birds with a double chevron. Bewick's Swan (*C. minor* or *Bewickii*) is another British species, which passes the winter in this country, flying northwards in spring. The length of this latter bird is 4 feet. It possesses an orange patch at the base of the bill. Through the peculiar arrangement of the trachea or windpipe, this bird, along with the Hooper or Whistling Swan (*C. ferus*), is able to produce a very grating noise. The latter species has a slender beak, black at its tip and yellow at the base, whilst it wants the black knot or tubercle on the beak. The cry resembles the word 'hoop;' and the windpipe is convoluted and protected by a modification of the ridge or keel of the sternum. This bird arrives in Britain in winter, departing north in April. The average length is 5 feet. The Black Swan (*C. atratus*) is an Australian species, first discovered in 1698; the general plumage is black, the bill being deep red and the primary wing-feathers white.

SWANEVELT, HERMANN, one of the most eminent landscape-painters of the Dutch school, is stated to have been born about 1618 at Woerden, and to have been a pupil of Gerard Douw, though both statements are very uncertain. It is certain, however, that he set out for Italy when very young, carefully studied the scenery of its beautiful districts, and, captivated by the pictures of Claude Lorraine, became a scholar of this famous master. He equalled, or perhaps surpassed, his master in his figures both of men and animals, and will always hold a first place among the greatest of landscape-painters. His etchings, 116 in number, partly of subjects of his own invention and partly of actual scenery, are very

much admired. His pictures, even during his lifetime, brought very high prices. He died at Rome, according to some authorities, in 1680; according to others, in 1690.

SWANSEA (Welsh, *Abertawe*), a mun., county, and parl. borough and seaport in Wales, capital of the county of Glamorgan, situated on the right bank of the river Tawe, at its mouth in Swansea Bay, 35 miles west-north-west of Cardiff. Besides churches of no special interest, the town contains a fine town-hall with a Corinthian façade; the Royal Institution of South Wales, including a library, museum, &c.; a large building in which are housed the public library, art gallery, and schools of science and art; a grammar, technical, and other schools; the general hospital, a deaf and dumb institution, a blind asylum, &c.; a theatre, an opera-house, and the Albert Hall; remains of an ancient castle dating in its present form from the fourteenth century, though first built in 1099; and several public parks. The harbour is an excellent one. To the present docks, North, South, and Prince of Wales's, a large new one will shortly be added. The staple industries of Swansea are the metallurgical, notably the smelting and refining of copper, gold, silver, and pyrites, which are imported for the purpose from many countries, the manufacture of tin-plate, and the working of iron, steel, zinc, nickel, lead, and other metals. Chemicals, patent fuels, and alkali are also made in considerable quantity, and there are flour-mills, ship-building yards, &c. Swansea is also a leading seaport, its imports (value in 1900, £4,682,410) being chiefly the raw material for its metallurgical industries, wheat and other grains, sugar, and timber; and its exports (value in 1900, £5,942,770) mainly coal, coke, and patent fuel, iron and iron and steel manufactures, wrought and unwrought copper, and chemical products (dye-stuffs, sulphate of copper, and carbide of calcium). Of the imports in 1900, metals and ores accounted for £3,853,450, mainly copper regulus and precipitate. Of the exports, iron and manufactures of iron and steel were valued at £2,570,159, coal, coke, and patent fuel at £2,254,836, and copper at £754,967. The total number of vessels which entered the port in 1900 was 5972, with a total tonnage of 2,053,705. Swansea has municipal tramways worked by electricity, and the town is served by the Great Western, London and North-Western, Midland, and some local Welsh railways. Under the 1885 Redistribution Act the town of Swansea returns one member to the House of Commons, and the Swansea district of boroughs, comprising the rest of Swansea, Aberavon, Neath, Loughor, and Kenfig, is represented by another member. The first charter of the borough was granted by King John, and subsequent charters were conferred by Henry III., Edward II., Edward III., and Cromwell. The copper industry of the town began to attain importance early in the nineteenth century, and since about 1830 the town has rapidly advanced in consequence of the development of this and other industries. Pop. of county borough, in 1891, 90,349; in 1901, 94,514; of Swansea town parl. bor. (1901), 63,478.

SWAZILAND, a native state of South Africa, south-east of the Transvaal. It is a fertile, mountainous country, believed to be rich in gold and coal. The Swazis are a section of the Zulus, but have always been firm allies of the British, and jealous of the encroachments of the Boers of the Transvaal. Notwithstanding this the latter gained such an influence in the country that, in 1895, Britain consented to Swaziland passing under their supremacy. Area, 7000 sq. miles; pop. (1894), 64,000.

**SWEABORG**, or **SVEABORG**, a fortress and naval arsenal of Russia, in Finland, 3 miles south-east of Helsingfors, occupying some small islands in the Gulf of Finland, all strongly fortified, and communicating with each other by bridges. The isle of Vargoe contains the principal works, bomb-proof magazines, &c. In 1855 Sweaborg was bombarded by the British and French fleets. Civil pop., 1000; garrison, 6000.

**SWEARING, PROFANE.** By act 19 George II. cap. xxi. every labourer, soldier, or sailor profanely cursing or swearing is liable to a penalty of 1*s.* for each oath; every other person under the rank of a gentleman, 2*s.*; and every gentleman, or person above the rank of a gentleman, 5*s.* for each oath, to be forfeited to the poor of the parish. Constables may bring the persons swearing before a justice of the peace, or if the oath is used in his presence the justice may convict summarily. In Scotland the penalty is fine or imprisonment, according to the person's rank.

**SWEAT.** See **PERSPIRATION**.

**SWEATING SICKNESS**, in medicine, a febrile epidemic disease of extraordinary malignity which prevailed in England at different periods towards the end of the fifteenth century and the beginning of the sixteenth, and spread very extensively in the neighbouring countries and on the Continent. It appears to have spared no age nor condition, but is said to have attacked more particularly persons in high health, of middle age, and of the better class. Its attack was very sudden, producing a sensation of intense heat in some particular part, which afterwards overspread the whole body, and was followed by profuse sweating, attended with insatiable thirst, restlessness, headache, delirium, nausea, and an irresistible propensity to sleep, together with great prostration of strength. The patient was frequently carried off in one, two, or three hours from the eruption of the sweat. It seems to have first appeared in the army of the Earl of Richmond upon his landing at Milford Haven in 1485, and soon spread to London. This body of troops had been much crowded in transport vessels, and was described by Philip de Comines as the most wretched that he had ever beheld, collected probably from jails and hospitals, and buried in filth. It broke out in England four times after this, in 1506, 1517, 1528, and 1551. The process eventually adopted for its cure was to promote perspiration and carefully avoid exposure to cold. The violence of the attack generally subsided in fifteen hours.

**SWEDEN** (called in Swedish, *Sverige*), a kingdom in the north of Europe, and forming with Norway, with which it is now united under one monarchy, the whole of the peninsula known in ancient times by the name of Scandinavia. Sweden itself is situated between lat. 55° 20' and 69° N.; and lon. 11° 40' and 24° E.; and is bounded north and west by Norway; south-west by the Skager-Rack, Kattegat, and Sound; south by the Baltic; east by the Baltic and the Gulf of Bothnia; and north-east by the Tornea and its affluent the Muonio, separating it from Finland. In addition to the mainland it has a great number of islands, the most of them of very small dimensions, and lying close to the coast. The largest, and also the most distant, is Götaland, or Gothland, in the Baltic. Sweden consists of the three historical divisions of Swealand or Sweden Proper in the middle, Götaland, or Gothland, in the south, and Norrland in the north. For administrative purposes it is divided into läns or governments. The area is estimated at 173,921 square miles, of which 8700 are occupied by the larger lakes; the pop. on 31st December, 1900, was 5,186,441. The area and population of Sweden and Norway together are as follows:—

	Area, sq. miles.	Pop.
Sweden (1900) .....	173,921	5,186,441
Norway (1900) .....	125,615	2,239,880
Total of two kingdoms, 299,536	.....	7,426,321

The towns in Sweden comprise a very small proportion of the total population. There are only five towns with a population exceeding 80,000, namely Stockholm (the capital), Göteborg or Gottenburg, Malmö, Norrköping, and Gefle. About 2,500,000 of the population are supported directly or indirectly by agriculture; about a quarter of a million are cultivators of their own land. There has latterly been a considerable amount of emigration.

**Surface Configuration.**—The coast-line, above 1400 miles in length, is serrated rather than deeply indented; its bays and creeks, though very numerous, having neither the width nor tortuous lengths by which the fiords of Norway are characterized. The west coast is very rocky, but seldom rises so high as 30 feet. Along the south and south-east coast low shores alternate with precipitous cliffs, which, however, are of no great elevation. As above stated many islets are scattered near the shores, and these where they form the archipelago of Stockholm are especially numerous. The whole of the upper part of the shore of the Gulf of Bothnia consists of sandy alluvial deposits, which are brought down by the rivers in such quantities that they seem destined at no distant period to convert a large portion of the gulf into dry land. It would appear, however, that alluvium is not the only agent employed in carrying on this process of shallowing, since it has been proved that the whole coast of Sweden is continually rising, the rise being greatest in the north.

The interior of Sweden is by no means generally mountainous, and its surface has far less of a high-land than of a lowland character. The most elevated portion of it commences in the west near the parallel of 62°, and is continued north along the frontiers of Norway, not so much in a continuous chain as in isolated mountain-masses rising from an elevated table-land, which, where loftiest, is at least 4000 feet, and forms the base of several summits which rise more than 6000 feet above sea-level, and owing to their high latitude are covered with perpetual snow. The two loftiest mountains, Sarjektjakko and Kebnekaise, both in Swedish Lapland, attain a height of about 7000 feet. Other lofty peaks are Sulitjelma and Sylfjellen, between lats. 63° and 67° on the Norwegian frontier. These mountains and their table-land slope east towards the Gulf of Bothnia, sending down numerous torrents, which in their course often expand and form chains of lakes and dreary swamps. The same slope is continued south of 62° N., but besides it there is a south slope which attains its lowest level near lat. 59° N., on the shores of the magnificent lakes which there stretch almost continuously across the country east to west. To the south of 59° N. the country is generally flat, though in many parts finely diversified. This region has several fertile and well-cultivated tracts, but a good deal of it is covered by barren sand or stunted heath, though interspersed with forests, green meadows, and cornfields. What is called the Plain of Scania, occupying the whole of the south peninsula between the Sound on the west and the Baltic on the south and east, is generally a fine tract of land.

**Rivers and Lakes.**—These are very numerous, and the latter in particular are on a large scale, giving to the scenery of the country several of its grandest features. The rivers all belong to the basins of the Baltic Sea and the German Ocean. The former receives the far larger share. To it belongs the Tornea, which rising in the Norwegian mountains, pursues

its course s.s.e. for nearly 290 miles, augmented by numerous large affluents, and falls into the northern extremity of the Gulf of Bothnia; the Luleå, Piteå, Skellefteå, and united Windel and Umeå, which flow precipitously south-east into the same gulf; the Ångermann, which flows 230 miles, and in the lower part of its course becomes so wide and deep that vessels of 600 tons can ascend nearly 70 miles from the sea; and the eastern and western Dal, which, uniting their streams, receive the discharge of numerous lakes, and pursue a more circuitous course than usual in Swedish rivers. The principal rivers belonging to the basin of the German Ocean are the Klar and the Göta, the former of which, issuing from Lake Fämund on the edge of the Dovrefield Mountains, furnishes Lake Wener with its chief supply of water; while the latter, which may be considered only as its continuation, discharges it into the ocean. The lakes not only add to the beauty of the scenery, but yield large supplies of fish, and both by their natural depth and the canals which have been cut to connect them, are of vast navigable importance, and furnish a long line of internal communication. In this way a direct channel has been opened from Göteborg on the west to Söderköping on the east coast, and communicating with the important towns of Wenersborg, Carlstad, Mariestad, Jönköping, and Linköping. In the same manner the capital has been enabled to extend its connections with the interior. In general, however, the rivers are too rocky for navigation. The largest lake is Lake Wener (area 2014 square miles); the next in size Lake Wetter (715 square miles). Lake Mälär, better known than the other large lakes, from having the capital on its shores, is also remarkable for the number of islands which so crowd its surface that it is scarcely possible to find a square mile of open water. Hjelmär, which has both a natural and an artificial communication with Lake Mälär, has an area of 188 square miles.

*Geology and Minerals.*—Almost the whole of the country is composed of gneiss, partially penetrated by granite. Patches of porphyry and greenstone, of Silurian rocks, of oolite, and of cretaceous rocks, appear in various localities. The minerals include gold, which was worked on the table-land of Småland till it ceased to pay the expenses; silver, found in limited quantities in several places, particularly Sala in län Westeraås and the vicinity of Falun; copper, found chiefly near Falun, and smelted to a considerable extent at Stora-Kopparberg; rich mines of cobalt, particularly in län Örebro; a little lead; and inexhaustible supplies of iron. The last, indeed, not only occurs in beds of immense thickness, inclosed in strata of gneiss, but forms the principal mass of whole mountains. The most celebrated iron-mines are those of Danemora in län Upsala, where the iron worked is perhaps the best in the world, and is admirably adapted for steel. The quantity produced, however, is much smaller than in some other districts where the quality is also excellent. Coal exists in considerable quantity, but is little worked. Some mines have been opened in the south, but the yield has hitherto been inconsiderable, and the coal being of the newer formations, is poor in quality.

*Climate.*—The climate of Sweden varies considerably with the latitude and elevation. There is hardly any spring or autumn intervening between the heat of summer and the cold of winter, but in the north the winter lasts for nine months, in the south only for seven. Speaking generally, the climate of Sweden, though modified by the proximity of the sea, so as to be milder in all respects than the interior of the northern parts of the Russian and Asiatic continents, is much more extreme than that of our own island, even where the two countries are in the same lati-

tude, and experiences greater degrees both of cold and heat. Hence at Stockholm, which is in the latitude of the Orkneys, the thermometer has been known to descend 26° below zero in January, and to rise in July to the almost tropical heat of 96° 8. The climate, however, is eminently favourable to health, and no country furnishes more numerous instances of longevity.

*Vegetation, Agriculture, &c.*—In the very northern extremity of Sweden, at least in those parts where the surface is not very elevated, fine trees of pine, fir, and birch are found. These, however, occupy only occasional patches, and the true forest-land must be considered as having its limit near 64°. Below this latitude, and chiefly in the central and southern parts of the kingdom, the forests occupy at least one-fourth of the whole surface, and sometimes stretch continuously for 80 miles in length by 20 miles in breadth. Many of these, however, consist of trees of stunted growth, available chiefly for domestic fuel or the supply of the smelting furnaces, and seldom of much use as timber. Forests in which oak and beech are the prevailing trees occur only in the south. Only a small portion of the arable land, and that mostly in the south, is favourable for the growth of wheat; but there is now a considerable export of oats and some of other cereals to Great Britain. Until recently the grain grown in Sweden did not suffice for domestic consumption. Potatoes are grown in almost all parts of the country, and form one of the main articles of food among the lower classes. The most important auxiliary crops are beet-root for sugar, hemp and flax, the latter of excellent quality; on a few favoured spots tobacco, hops, and madder are grown. Cherries, apples, and pears are tolerably abundant in the southern districts. The principal domestic animals are cattle, sheep, and reindeer. The last, necessarily confined to the north, are kept in large herds by the Laplanders, and supply them at once with food and clothing.

*Zoology.*—Among the larger wild animals the wolf and bear abound in the forests, and often commit great ravages. The elk and deer are also found, but in more limited numbers. Of smaller animals the most destructive is the lemming, which at intervals of years descends in immense numbers into the low country and lays it waste. Among birds the most remarkable are eagles, capercaillies, and woodcocks. The rivers and lakes are well stocked with salmon and trout, but the fisheries on the sea-coast have long ceased to be productive. Herrings, which used to visit the coast of the Baltic in large shoals, have almost entirely disappeared, though large numbers of a fish resembling herrings, and called *strömmings*, are taken along the east coast.

*People.*—Almost all the inhabitants of Sweden, with the exception of the Laplanders and Finns, found only in the north, are of Teutonic origin, and preserve the original features of the race in great purity, particularly in the central and southern provinces, where they are characterized by a tall robust stature, light hair, blue eyes, and light complexions. They are active and enterprising, and manifest a marked predilection for scientific pursuits. The state of morality is on the whole favourable. Heinous crimes are few, but a great number of minor delinquencies figure in the calendar, and are evidently accounted for by the far too prevalent use of ardent spirits, but a considerable improvement in respect of the consumption of intoxicants seems to have taken place in recent times. Almost all the inhabitants belong to the Evangelical Lutheran Church, at the head of which is the Archbishop of Upsala. Other religions are tolerated; but appointments in the

public service can be held by Lutherans only. Education is gratuitous and compulsory. Primary education is well diffused, and the University of Upsala has done much to foster the cultivation of the higher departments of science and scholarship. There is also a university at Lund. See SCHOOLS.

*Constitution and Government.*—The crown is hereditary in the male line. The king must be a member of the Lutheran Church, and has to swear fidelity to the laws of the land. His prerogatives consist of the right to preside in the high court of justice, to grant pardons, to conclude treaties with foreign powers, to declare war and peace, to nominate to all appointments civil and military, and to veto absolutely any decree of the diet, or parliament of the kingdom. He also possesses a power of administrative legislation. (For the constitution of Norway, which differs both as to the powers of the king and in other respects, see NORWAY.) The princes of the blood-royal are excluded from all civil employments. The diet consists of two chambers, which are both elected. The first or upper chamber consists of 150 members. The members are elected by twenty-five provincial landstings (or provincial assemblies), and the corporations of Stockholm, Göteborg, Norrköping, Malmö, and Gefle. All the members must be above thirty-five years of age, and a property qualification is required to the taxed value of 80,000 kronor, or £4450, in real property, or an annual income of 4000 kronor, or £223. They are elected for nine years, and serve gratuitously. The second chamber contains 230 members, 150 elected by the rural population, being one for each 40,000 inhabitants; and eighty by the towns, being one for every 10,000 inhabitants. The electoral privilege is limited to natives of Sweden, aged twenty-one, possessing real property to the taxed value of 1000 kronor, or £56, or farming for a period of five years landed property of the value of 6000 kronor, or £333, or paying income-tax on an annual value of 800 kronor, or £45; and all natives of twenty-five years of age, having the same qualifications, are eligible as members. Members are elected for three years, and are paid 1200 kronor, or £67, per session of four months, in addition to travelling expenses. The election is by ballot. The executive power is in the hands of the king, under the advice of a council of state consisting of eleven members, eight of whom are departmental heads. The eight departments are: the ministry of justice, the ministry of foreign affairs, the ministry of war, the ministry of marine, the ministry of the interior, the ministry of finance, the ministry of education and ecclesiastical affairs, and the ministry of agriculture. All the ministers are responsible for the acts of the government. The administration of justice is controlled independently of the government by the Justitie Kansler, appointed by the king, who acts for the crown; and the Justitie Ombudsman, appointed by the diet, who exercises a supervision over the law-courts.

*Revenue and Expenditure.*—A large part of the revenue is derived from national property, including railways; the remainder from customs, excise, income tax, &c. The total estimated revenue for 1902 amounted to £8,870,000, and the expenditure to the same amount. Part of the expenditure—civil, military, and ecclesiastical—is defrayed from crown lands, and does not appear in the public accounts. The public debt on the 1st of Jan., 1901, amounted to over £18,500,000. Sinking-funds are provided for the payment of the debt.

*Army and Navy.*—The army has hitherto consisted of enlisted troops, a militia maintained by land-owners and crown domains, and conscription

troops, drawn by annual levies; but by a law of 1901 it is now undergoing reorganization, which will take some years to complete, the result being an increase in numbers. Military service is compulsory between the ages of twenty-one and forty. The whole military force amounts to about 490,000 men, comprising some 39,000 soldiers of the line, a reserve of 250,000, and the Landstorm of about 200,000. The fleet consists of 23 coast-defence vessels; 5 torpedo cruisers; besides gunboats, torpedo-boats, &c.

The Norwegian army, which is on a separate footing from that of Sweden, comprises troops of the line, the Landvaern, and the Landstorm. All young men over twenty-two years of age are liable to military service. The nominal period of service is sixteen years, namely, six years in the line, six years in the Landvaern, and four years in the Landstorm. The troops of the line actually under arms can never exceed, even in time of war, 18,000 men without the consent of the Storting.

*Trade and Industry.*—Of all the countries trading with Sweden, Britain is the one with which the largest amount of business is done, Germany coming next. The total value of the exports to all countries in 1899 was nearly £20,000,000, the exports to Britain amounting to £10,000,000. The total imports, again, amounted to £28,000,000, the imports of British produce being £4,796,316. The principal exports are timber, iron, butter, and wood pulp. In 1901 the exports of timber to Great Britain amounted to £4,726,401; iron and steel, and iron and steel manufactures, £1,173,500; butter, £938,889; paper-making materials, £843,882. Among the exports of British home produce to Sweden, the largest items were iron and steel, wrought and unwrought, £615,275; coal, £1,728,009; cotton manufactures, £322,709; woollen manufactures, £187,699; machinery, £230,065. The mercantile marine of Sweden consisted in 1900 of 2912 vessels, with a burden of 587,669 tons. Next to agriculture the most important industry in Sweden is iron-mining. Other industries now of some importance are iron-founding and engineering, the spinning and weaving of cotton and woollen goods, paper-making, brewing, sugar-refining, match-making, and glass-making. There are over 7000 miles of railways, of which over 2400 miles belong to the state. The public telegraph and telephone lines belong wholly to the state.

*Weights and Measures.*—The denominations of money are the öre and the krona, or crown (silver); 100 öre (each = .132d.) = 1 krona = 1s. 1½d. The greater part of the currency, however, is in paper, which is circulating in sums varying from 5 to 1000 kronor. The metric system of weights and measures was introduced in 1883. Among old measures are the *skulpund* = .937 lb. avoirdupois; the *centner* (100 skulpund) = 93.7 lbs. avoirdupois; the *nylät* (100 centner) = 83.67 cwts.; the *kanna* = 4.6 pints imperial; the cubic *fo*t (10 kanna) = 5.76 imperial gals.; the cubic *aln* = 46 gals.; the foot (*fo*t) = 11.689 inches imperial; the *tunneland* or acre = 1 acre 35 poles; the mile = 6.64 English miles, and the square mile = 44 English square miles; 10 *linier* = 1 *tum*; 10 *tum* = 1 foot; 10 feet = 1 *stäng* (= 9.74 English feet); 10 *stänger* = 1 *ref*; 360 *ref* = 1 mile.

*History.*—In the case of Sweden, as of many other countries, the industry of chroniclers has supplied details about ages with which they were unacquainted. These early chronicles, called Sagas, contain lists of kings at variance with each other, and stories of adventure of the kind to which the epithet heroic is usually applied, in which it is impossible to separate the fabulous from the historical. The first dynasty of Swedish kings, according to the legendary chronicles, belonged to a family called Ynglings, from their

founder, Freyer Ingve, the reputed grandson of Odin, from whom the family claimed to be descended. The last of them was expelled by Ivar Widfadm, representative of the Danish family of the Skioldings, also descended from Odin, who united Sweden and Denmark under one rule. This event is referred to about A.D. 680. Near the end of the following century Ragnar Lodbrok, the reigning representative of this house, fell in battle on the English coast, and his second son, Björn Ironside, inherited Sweden, which was again separated from Denmark. Christianity was introduced under his grandson, Björn II.; but it was first established by Olaf, who reigned in the beginning of the eleventh century (A.D. 1001-26). Until the beginning of the twelfth century the chronicles contain rival lists of kings. From the first appearance of Sweden in history two rival tribes or confederacies, both of German origin, the Goths and the Swedes, contended for the ascendancy in it, and the confusion of the chronicles is probably due to the mingling of the lines of separate chiefs or monarchs reigning simultaneously in different districts. Edmund Slemme, the last of the descendants of Björn, was defeated and killed by the Goths in 1056, when the two nations were united under Stenkil, the Gothic monarch. On the death of his descendant Inge II., in 1129, the Swedes raised a private individual, Sverker I., to the throne. To conciliate the Goths it was agreed that Erik, a descendant of Stenkil in the female line, should succeed Sverker, and that the two families should reign alternately. This arrangement, which seems to indicate that the power of the monarchs was merely that of leading chiefs, was continued, though the cause of much dissension and civil war, for several reigns. During the reign of Sverker the kingdom was divided into four dioceses (1152). Erik IX., called St. Erik, succeeded about 1155. In his reign the Finns were conquered and converted to Christianity. Charles VII., son of Sverker, who succeeded about 1162, was defeated and killed by Knut Erikson, who succeeded in 1168. Sverker II., the son of Charles, was likewise defeated and killed by Erik X., son of Knut, who succeeded him in 1210. John I., son of Sverker II., and the last of his line, was succeeded in 1253 by Erik II., the last of his, who died in 1250. Waldemar I., nephew of Erik, was raised to the throne by election, and founded the dynasty of Folkungar. Waldemar made a voyage to the Holy Land, leaving his brother Magnus regent, in 1272; on his return a civil war took place, but Waldemar abdicated in favour of Magnus in 1279, and failed in subsequent attempts to recover the throne. Magnus assumed the title of King of the Swedes and the Goths. His son, Birger II., in whose reign the conquest of Finland was completed, was expelled by the people in 1319, who chose his nephew, Magnus Snek, an infant, as his successor. He had already succeeded, in right of his mother, to the crown of Norway, which he gave to his son Haac in 1344. Scania, consisting of the two southern provinces Malmöhus and Kristianstad, which then belonged to Denmark, yielded to him in 1332, but he restored them on affiancing his son Haac to Margaret of Denmark. Magnus was deposed by the estates, and obliged to carry on a civil war for the crown with his son Erik, whose death again left him in possession of the kingdom; but aiming at absolute power, he was again deposed in 1365 in favour of his nephew, Albert of Mecklenburg, who had already been in possession, since 1363, of the supreme authority. Albert formed a league with Schleswig, Holstein, Mecklenburg, and the Hanse Towns against Denmark and Norway. He succeeded in driving the King of Denmark out of his dominions, but was defeated by the King of Norway, who

besieged him in his own capital. Peace was concluded; but Albert, aiming, like his predecessor, at absolute power, made himself unpopular with his own subjects, who invited Margaret of Denmark and Norway, the Semiramis of the North, who had united the crowns of these kingdoms, to replace him. Albert, though supported by Holstein, Mecklenburg, and the Hanse Towns, was finally overcome, and returned to Mecklenburg. Margaret succeeded in 1389, and by the union of Calmar (see CALMAR) the three kingdoms were formally united, each retaining its own constitution. Under the reign of her grand-nephew Erik (1412-41) the Swedes revolted under Engelbrecht (1438). The union was renewed 1436, but both Danes and Swedes revolted against Erik, and Charles Knutson, grand-mareschal of Sweden, was chosen regent. His rule proving oppressive, the joint crown was conferred in 1441 upon Christopher of Bavaria, nephew of Erik. On his death in 1448 Charles VIII. (Knutson) was chosen King of Sweden. Norway also acknowledged him, but soon threw off the yoke. The severance of the union also produced a war with Denmark. Charles's reign was stormy, and his subjects repeatedly revolted against him. He died in 1470. Christian I., king of Denmark, had been crowned King of Sweden in 1458 by the party opposed to Knutson, but on the death of Knutson his party chose his nephew, Sten Sture, administrator of the kingdom. Christian attempted to take possession of the kingdom, but was defeated and forced to retire. In 1483 John I., son of Christian, was recognized as King of Sweden in virtue of the Union of Calmar. The country was divided between the Danish and the national parties, but Sture contrived to hold the administration, and raised an army to drive the Russians out of Finland. In 1497 John invaded Sweden with a powerful army. Sture was completely defeated at Rotebro, 28th October. John conferred on him the government of Dalecarlia; but the Swedes again revolted, and proclaimed him administrator in 1501. He died in 1503, and was succeeded in the administration by Svante Sture, who concluded peace with Russia, and formed an alliance with the Hanseatic towns, in order to prosecute the war with Denmark. The clergy and a large portion of the senate favoured the Danish alliance, but the peasantry were strongly opposed to it. Svante Sture died in 1512, and was succeeded by his son, Sten Sture the Younger. In the following year Christian II. succeeded to the crown of Denmark. The leading events which took place from this time till the death of Sture in 1520 are detailed in our biography of CHRISTIAN II. After the death of Sture Gustavus Vasa raised the peasants of Dalecarlia, defeated the Danes, and, having embraced the Lutheran religion, was crowned king by a Protestant Archbishop of Upsala in 1523. The Lutheran religion was formally established in Sweden in 1529. Christian II. having been driven from Denmark, his title was acknowledged by his successor, Frederick I., and in 1544 was declared hereditary in his house. He died 29th September, 1560. (See GUSTAVUS VASA.) His son, Erik XIV., reigned only eight years. Erik was one of the candidates for the hand of Queen Elizabeth of England, and also of Queen Mary of Scotland. He subsequently married his mistress, the daughter of a subaltern in his guards. His temper was violent, and became continually more so, until it became evident that he had lost his reason. He imprisoned his brother John, and massacred the Sture family and others of his subjects on the ground of frivolous suspicions. In a fit of remorse he set Erik at liberty, who conspired against him with his brother Charles. John surrendered to them in September 1568, and early in the following

year he was deposed. He was barbarously treated, and nine years afterwards was poisoned by John in prison. To balance the power of the great nobles Erik created a secondary nobility, and introduced the titles of count and baron into Sweden. A war with Russia, undertaken for the protection of the Teutonic order, resulted in the acquisition of Esthonia to Sweden; but war having subsequently broken out with Denmark was, in the confusion caused by the king's insanity, ill-conducted, and resulted in repeated disasters to the Swedes. John III., the brother of Erik, succeeded him on his deposition. By the Peace of Stettin with Denmark, signed 13th December, 1570, Sweden renounced her claims to Norway, and surrendered a large part of Götland, including the west coast, to Denmark. This treaty was made with a view to a war with Russia. In this war the Swedes were successful in foiling the designs of Ivan IV. on Livonia. Peace was concluded in 1582. John had married Catharine Jagellon, daughter of Sigismund, king of Poland, and through her influence endeavoured to restore the Catholic religion in Sweden. The clergy, who sanctioned his brother's murder, proved obsequious; but a formidable opposition arising, headed by his brother Charles, and the queen dying, he abandoned the project. Sigismund, his son, was, however, brought up in the Catholic faith, and in 1587 he was elected King of Poland under the title of Sigismund III. John died 17th November, 1592. Charles, duke of Sudermania, who held the regency in the absence of his nephew Sigismund, endeavoured to deprive him of his crown on the ground of his religion, but on the return of Sigismund with an army he was compelled to relinquish the government to him. Sigismund, on receiving the crown, returned to Poland, and left his uncle Charles regent. Charles again attempted to seize the crown, and defeated Sigismund in the battle of Stångbro (Sept. 1598). The states now conferred on him the title of hereditary prince, and insisted upon Sigismund sending his son to Sweden to be educated in the evangelical faith. Failing to comply, he and his posterity were excluded from the crown, and in 1604 Charles was acknowledged as king elect of the Swedes, Goths, and Vandals, and his son, Gustavus Adolphus, was recognized as his successor. He took the title of Charles IX. From these events arose a war with Poland, which was not terminated by a permanent peace till 1660. Wars also with Denmark and Germany continued till the end of Charles's reign. Charles IX. died 8th Nov. 1611, and was succeeded by his son, Gustavus Adolphus, then engaged in conducting the war with Denmark. One of the first acts of Gustavus was to select as his chancellor Axel Oxenstiern, who became one of the first statesmen of Europe. Failing to make peace with Denmark, Gustavus took the field in person, and nearly lost his life in the battle of Widsjö; but in 1613 he succeeded through the mediation of England in making peace. The Russian throne was then vacant. The Swedes and Poles each set up candidates for it, Charles Philip, brother of Gustavus, and Ladislaw, son of Sigismund. Both had invaded the country and made extensive conquests, and Gustavus granted favourable terms to Denmark that he might turn his attention to this quarter. Michael Romanoff, elected in 1613, was compelled to make peace with Sweden by the cession of all his Baltic provinces (see RUSSIA); and Sweden, which notwithstanding internal troubles had been advancing in political importance since the time of Gustavus I., now became the leading power of the North. The war of Succession with Poland still continued, and in 1621 Gustavus turned his arms against that country and captured Riga. The war continued for nine years, and was concluded by the six years' truce of

Altmark in 1629. Gustavus retained four frontier towns of East Prussia. Sweden was now about to take for the first time a leading part in the affairs of Europe. Gustavus had been watching with anxiety the course of events in Germany (see GERMANY), and had determined to interfere on behalf of the interests of religion and the political rights of the Protestant princes. For the events of this war and the effects of the intervention of Sweden in the affairs of Europe see GUSTAVUS, PRUSSIA, RICHHELIEU, THIRTY YEARS' WAR, and other articles. The body of Gustavus, who fell at the battle of Lützen, was brought back to Sweden in 1632, and his daughter Christina was recognized as his successor. By the event of this war Sweden was deprived of one of her greatest rulers in the prime of his youth. His daughter was a minor, and the management of affairs devolved upon the Chancellor Oxenstiern. He confirmed his alliance with the German rulers, and made arrangements to prosecute the war with vigour. (See OXENSTIERNA, AXEL.) His power continued absolute till 1644, during which time the war in Germany continued. At the beginning of this year a war broke out with Denmark, provoked by the scheming of the queen-mother, who was jealous of the power of Oxenstiern. Denmark was suddenly invaded by Torstenson. Christina assumed the reins of government on 5th December, 1644, her eighteenth birthday. The peace party now prevailed, and the treaty of Brömsebro was concluded with Denmark, which ceded to Sweden the greater part of her possessions in Götland, and exempted Swedish vessels from Sound and Belt dues. The Peace of Westphalia, 24th October, 1648, gave Sweden Western Pomerania, the duchy of Bremen and other acquisitions in Germany, with a seat and triple vote in the diet. The reign of Christina began under favourable auspices. She had received a masculine education, and showed great attention to business and determination in supporting her views. Contrary to the advice of Oxenstiern she exerted herself to promote peace both with Denmark and Germany. She patronized learning, and drew many distinguished men to her court; but she was extravagant in her expenditure, licentious in her behaviour, and soon brought herself into inextricable difficulties by the profusion with which she lavished the crown domains on worthless favourites. In these circumstances she renounced the crown in 1654 in favour of her cousin Charles Gustavus, son of the count palatine, professed the Catholic religion, and after an extraordinary career died at Rome in 1689. (See CHRISTINA.) The short reign of Charles X. was distinguished by some brilliant military enterprises, which extended to Poland, Prussia, Russia, and Denmark. In January, 1658, he crossed the sea on the ice, and occupying the island of Fünen without resistance, advanced to Copenhagen. By the mediation of England and France peace was concluded at Roeskilde, 8th March, 1658, Denmark surrendering the remainder of her possessions in Götland. Charles, however, had set his heart on the conquest of Denmark, and was not long in recommencing operations against this country. He died suddenly on 13th February, 1660, leaving a son, Charles XI., only four years of age. A council of regency was appointed, which soon concluded peace with Poland, the emperor and the Elector of Brandenburg. Peace with Russia was not concluded till 1661. Sweden formed an alliance with England against Holland in 1665, and took part in the triple alliance against France in 1668. The common policy of Sweden was to ally herself with France, and her change of policy was due to the failure of French subsidies. By the Treaty of Stockholm, concluded 14th April, 1672, she

agreed to assist France if attacked by any German power during her war with Holland. In consequence of this treaty the Swedes invaded Brandenburg in 1674. They were defeated by the elector at Fehrlin, 28th June, 1675. After this victory Denmark entered into a league with the elector against Sweden. In the hotly contested war which ensued Sweden was defeated by the elector on land and by the Danes at sea, but her ally was victorious, and Louis XIV. compelled the elector by the Treaty of St. Germain-en-Laye to restore to Sweden all her German possessions except a district beyond the Oder, and by the Treaty of Fontainebleau Christian V. engaged to restore all his conquests to Sweden. Peace was concluded on these terms between Sweden and Denmark at London, 26th September, 1679. Sweden, whose financial resources were always limited, had, however, been impoverished by the war, and the nobility, who during the minority of Charles had acquired the chief power in the state, although the king had assumed the government in 1772, became unpopular. A revolution was accomplished in 1680, in which the states, under the guardianship of a military force, declared Charles absolute and irresponsible, and entitled to dispose of the government by his last will. By a subsequent diet donations and leases of crown lands since 1632 were revoked. This gave the greater part of Livonia to the crown. The remaining years of Charles XI. were employed in organizing the army and restoring the finances. He adopted a regular system of conscription, which greatly strengthened the military power of the nation. He died 15th April, 1697. His son, Charles XII., born in 1682, was declared of age in November. Of the warlike monarchs of Sweden he is the one who has attained the highest reputation for military genius. The events of his romantic reign are detailed in our biography. (See CHARLES XII.) His youth, as is well known, induced Denmark, Poland, and Russia to enter into a league against him to partition his dominions. Embarking for Copenhagen in 1700 he soon disconcerted the plans of the allies, and refusing peace began a career of conquest, which after many marvellous successes ended in the disastrous battle of Poltava, 8th July, 1709. After an exile in Turkey he returned to Sweden in 1714, reconciled himself with Peter the Great, and was pushing the conquest of Norway when he was killed at the siege of Frederickshall, 30th November, 1718. Charles's great struggle was against Russia, and in it he succumbed. The event, as often happens in war, was only the anticipation of what was inevitable. In military organization and skill Sweden had every advantage over her rival, but the natural advance of Russia would soon have made her the leading power of the North, and the ambition of Charles only precipitated the downfall of his own kingdom, and compelled her to yield the precedence to her rival a few years sooner than she might otherwise have been obliged to do. The Swedish states, passing over Charles Frederick, son of Charles's elder sister, named the second sister of Charles, Ulrica Eleonora, queen, who in 1720 associated with her her husband Frederick I. The revolution was accomplished so suddenly that it led to a suspicion that Charles's death had been anticipated, and it has always been suspected that he fell by the hand of an assassin. Although peace had not been formally concluded, Charles had in his later years, under the influence of Baron Görz, been drawn into an alliance with Russia. The new government allied itself with Great Britain, and ceded the Duchies of Bremen and Verden, the cause of quarrel between Charles and England, to George I. Peace was concluded with Poland on the basis of the Treaty of Oliva, and with Prussia, to which Sweden ceded the terri-

tory between the Oder and the Parna, Stettin, the Islands of Wollin and Usedom, &c. By the Treaty of Stockholm, June 12, 1720, Sweden paid Denmark 600,000 rix-dollars, and renounced the freedom of the Sound, while Denmark restored Rügen and other conquests in Pomerania and elsewhere. War still continued between Sweden and Russia. It was concluded by the Treaty of Nystadt, 10th September, 1721, for the terms of which see RUSSIA. Sweden received 2,000,000 dollars for Livonia, but she finally lost the valuable Baltic provinces for which she had so long contended. Of her conquests Russia only restored Finland. Sweden was now under the hands of an oligarchy, the chief power in the state being held by a secret committee of 100 members: 50 of the order of nobles, 25 of the clergy, and 25 of the burghers. This council was easily bribed by foreign powers. It was divided into two factions, called (after 1738) the Hats and Caps, the former of which preferred to sell themselves to France, the latter to Russia. On the breaking out of the war of the Austrian Succession, the Swedes, who had been irritated by the murder, at the instigation of the Russian Empress Anna, of their ambassador to the Porte, were easily induced by France to declare war with Russia. The war on the part of Sweden, from military incapacity and the selfishness of her civil rulers, was ill conducted. On the accession of Elizabeth peace was concluded by the Treaty of Åbo, 17th-18th August, 1743, by which Sweden renounced for ever her claim to the provinces ceded by the Treaty of Nystadt, the recovery of which was the main object of the war, and ceded part of Finland, the boundary between the two states being fixed at the river Kymen. By the influence of Russia Adolphus Frederick of Holstein was elected successor to the Swedish crown, to which he succeeded on the death of Frederick in 1751. During this reign Sweden took some part in the Seven Years' war. At home the country was distracted by the rivalries of the Hats and Caps, and the royal power sank to a shadow. Adolphus died in 1771, and was succeeded by his son Gustavus III. His reign was distinguished by a monarchical revolution. (See GUSTAVUS III.) He undertook a war against Russia, which brought him fame indeed, but was productive of no other result. Gustavus was assassinated in 1792. His son Gustavus IV. was deposed, and his family declared for ever incapable of succeeding to the crown, in 1809. The leading events of his reign will be found under GUSTAVUS IV. His uncle, the Duke of Sudermania, was declared king with the title of Charles XIII. (See CHARLES XIII.) He concluded a war with Russia, begun by Gustavus, by the Treaty of Fredericksham, 17th September, 1809, by which Sweden surrendered Finland, the Åland Isles, and part of West Bothnia to Russia. In 1810 the states elected Jean Baptiste Bernadotte, crown-prince. (See BERNADOTTE.) In the final struggle with Napoleon previous to 1814 Sweden joined the allies, while Denmark took the part of France. The Danes were driven out of Holstein by Bernadotte, and the Treaty of Kiel was concluded between Sweden, Denmark, and Great Britain, Jan. 14, 1814. Sweden by this treaty ceded to Denmark her last German possessions in Pomerania, and the Isle of Rügen, while Denmark was compelled to cede Norway to Sweden as a compensation for the loss of Finland. The cession was confirmed by the Norwegian Storting on November 4. Greenland, the Faroe Islands, and Iceland, which had belonged to Norway, were retained by Denmark. Sweden now held the whole Scandinavian Peninsula, and had lost all her other European possessions. Bernadotte succeeded to the crown in 1818, under the title of Charles XIV. Under his reign Sweden advanced greatly in agricultural and mercantile prosperity.

He died in 1844, and was succeeded by his son Oscar I. He introduced extensive reforms in the government. (See OSCAR I.) He died 8th July, 1859, and was succeeded by his son Charles Louis Eugene, under the title of Charles XV. He continued the reforming career of his father. In 1866 the states, which from time immemorial had met in four chambers, representing the nobility, the clergy, the citizens, and the peasants, were reduced to the modern composition of two chambers. Other political reforms were instituted both in Sweden and Norway. Charles XV. died 18th September, 1872, and was succeeded by his brother Oscar II., under whom the question of free-trade against protection, and the increase of the defensive force of the country, have caused a good deal of discussion. Latterly Norway has shown signs of desiring entire separation from Sweden, republicanism being strong in Norway.

*Language and Literature.*—The Swedish language is a descendant of the Norse, the original of the Scandinavian branch of the Germanic tongues, of which the purest representative at the present day is the Icelandic. It is a much more legitimate descendant of the parent language than the Danish, which has suffered much more admixture with the German; both its grammatical structure and its vocabulary are more purely Scandinavian, yet intercourse with other races has in course of time considerably modified the Swedish also. Commercial intercourse with the Hanse towns early brought a German influence to bear upon the language, while the services of the church and the training of the clergy—everywhere the chief custodiers of literature—subjected it to the influence of Latin. After the Union of Calmar it was brought into closer contact with the Danish, which for a time became the channel through which external influences were most largely communicated to it. Through the Reformation and the translation of the Bible Teutonic elements were more directly imported, and in the eighteenth century the ascendancy of French literature led to the infusion of Gallic forms and expressions. In the latter half of the seventeenth and the early part of the eighteenth century a purist reaction set in, and a similar movement followed the period of French ascendancy, by which the language was purged of many foreign elements, and Scandinavian forms and derivatives substituted for those of exotic growth. As might be anticipated from the various influences to which it has been subjected the Swedish language is broken up into numerous dialects. That of Södermanland is the nearest to the written language; those of Dalecarlia and Götland are the most remote from it. That of Malmöhus, Kristianstad, and Blekinge, the southern provinces of Götland, approaches nearest to the Danish; that of Norrland to the Icelandic. Swedish is the language of the educated classes and of the press in Finland.

The Swedish alphabet has twenty-eight letters, being all the English letters except *w*, together with the modified vowels *ä*, *ö*, pronounced as in German, and *ë*, pronounced as the English *o* in *note*. *O* is pronounced like *o* in *move* or *a* in *fall*. *G* sounds like *y* before *e*, *i*, *y*, *ä*, *ö*; *k* before the same vowels like *ch* in *chair*; *sk* or *skj* like *sh*. There are, as in other Germanic languages, a strong and a weak form of the verb. The present and imperfect tenses are formed by inflection, all others by auxiliaries. In conversation persons not inferiors or intimates are addressed in the third person, with the titles Herr, Fru, and Mamsell. The best grammars are those of Fryxell, Rydqvist, and Strömberg; the best dictionaries those of Ihre (1769) and Dallin (1850-54). The German grammar of Dietrich and the English of May may also be mentioned.

The earliest writings extant are the ancient provincial laws. The oldest compilation of these, that of Wester Götland, is attributed to the middle of the thirteenth century. The earliest ballads belong to the thirteenth century, and in the two following centuries they are more abundant. They are sung to characteristic melodies, frequently of great beauty. In the fourteenth century translations of the chivalric romances of Southern Europe were introduced, and were followed by imitations and original compositions of the same kind. To the pre-Reformation period also belong some collections of provincial laws, Biblical and theological translations, and chronicles. The University of Upsala, founded by Sten Sture in 1478, and reconstructed and endowed by Gustavus Adolphus in 1624, became, particularly after the latter date, a powerful means of promoting literary culture and higher education in Sweden. Printing was introduced into Stockholm in 1483. The first book printed was a book of moral fables. During the sixteenth century the literature, influenced by the Reformation, was chiefly polemical. Printing-presses were established at Upsala, Westerås, Söderköping, and Malmö. The earliest translation of the New Testament (1528) was by Olaus Petri, who also published the first sermon in 1528, the first catechism in 1530, and the first drama, *Tobias Comedia*, in 1550. His brother, Laurentius, the first Protestant archbishop of the kingdom, translated the Old Testament, published in 1541, and composed thirty-four hymns, which were long in use in the church. A Swedish chronicle, *Svenak Krönika*, was written by Olaus and revised by his brother. The *Rödboken*, a liturgy of Romanist tendencies, was published in 1576. The 'Thirty Years' war exercised a very favourable influence on Swedish literature. Several libraries captured by Gustavus were sent into Sweden, and the political importance of the country increased its influence with the rest of Europe, from which it had hitherto been too much isolated. Christina, as already noticed, became a liberal patron of literature, and brought many learned men to Sweden. The linguistic reformation of the seventeenth and eighteenth centuries already adverted to was chiefly characterized by the study of Icelandic remains, the publication of works on the language, and of early Icelandic texts. Among those who distinguished themselves in this work were Olof Verelius and Olof Rudbeck. Among the ancient chronicles republished at this time the most notable is that of the Norwegian Snorri Sturluson. (See STURLUSON—SNORRI.) To this period belongs the Saxon Puffendorf, historiographer to the King of Sweden, who wrote in Latin on Swedish history and on national and international jurisprudence. Philosophy and natural science began now to be cultivated. Rudbeck (1630-1702) acquired celebrity as a botanist. Odelstjerna wrote on mineralogy. George Sternhjelm (1598-1672) wrote an epic on Hercules. He was also the first Swedish writer of sonnets. Dramatic writing was attempted with little success. In the eighteenth century the greatest name is that of Linnæus, the great naturalist (1707-78), who formed a school and left some distinguished successors, although the most celebrated of his pupils, Hasselquist (1722-52), predeceased him. The followers of Linnæus travelled widely to extend their knowledge of nature, and carried their investigations into many different branches of natural science. Torbern Olof Bergman (1735-84) and Karl Wilhelm Scheele (1742-86) became eminent as chemists, Celsius (1701-44) as an astronomer. The celebrated Swedenborg (1688-1772), whose father was a man of some distinction in literature, belongs to this epoch. Dalin, the historian, and Creutz and Gyllenborg, lyric poets, may also be mentioned. Mörk, the first

Swedish novelist, with Dalin, Wrangel, Hesselius, Celsius, and others, were followers of the French school. Queen Louisa Ulrica, the sister of Frederick II., was a patron of literature, and Gustavus III. both cultivated and patronized it, but his influence on it was not favourable. Karl Mickel Bellman (1740-95), was a song-writer of great merit, who set his own songs to music. The abolition of the liberty of the press in 1798 had a detrimental effect on literature. After the revolution of 1809 a reaction against French influence set in, and a vernacular style began again to be cultivated. In science Berzelius (1779-1844) has been recognized as one of the first chemists of the age. The nineteenth century has given rise to numerous political writers. In philosophy the Germans, chiefly Fichte, Schelling, and Hegel, are followed. Travellers are numerous, and works describing various regions of the earth abundant. The study of Icelandic, which had fallen into decline, has recently revived again, and other philological pursuits have also their followers. Theology is discussed by representatives of the various modern schools. Numerous contributions have been made to history and archaeology. The *Biographiskt Lexicon*, a dictionary of Swedish biography, edited by Palmblad, and continued by Wieselgren, is a work of great merit. F. M. Franzen (1772-1847), J. O. Wallin (1779-1839), P. D. A. Atterbom (1790-1855), Esaias Tegnér (1782-1846), considered the greatest of Swedish poets, and Johan Ludvig Runeberg (1804-77), are among the leading modern poets. Among modern novelists may be mentioned Palmblad, Almqvist, Engström, the Finn Snellman, Baron de Geer, Mellin, &c., as also three ladies, namely—Frederika Bremer, Mrs. F. Carlén, and the Baroness Knorring. Among still more recent writers are Zachris Topelius, poet and novelist; K. A. Wetterbergh (died 1839), novelist of everyday life; Victor Rydberg, novelist; and Anne Edgren, dramatist.

SWEDENBORG, EMANUEL, distinguished for his attainments in science and for his remarkable theological teachings, was born at Stockholm, in 1688. Educated by his father, Jesper Swedberg, bishop of West Gothland, his imaginative mind always possessed a religious turn. His studies embraced mechanics, mathematics, mining, chemistry, physiology, and most of the natural sciences. In 1710 he published at Skara some poems, under the title of *Carmina Miscellanea*. The period 1710 to 1714 he spent in scientific travels through England, Holland, France, and Germany, during which time he visited the universities of these countries. Having settled at Upsala, he published his *Dædalus Hyperboreus* (six numbers, containing experiments and observations in mathematics and natural philosophy). He had several interviews with Charles XII., who, in 1716, appointed him assessor extraordinary in the Royal College of Mines, and he formed an intimate connection for several years with Christoph Polhem, the Archimedes of Sweden, whose experience was of great service to him. The invention of a rolling-machine, by means of which he conveyed a sloop, two galleys, and five large boats (which Charles XII. used, in 1718, to transport cannon to the siege of Frederickshall) about 14 miles over mountains and valleys, from Strömstadt to Iddefjord, and his treatises on algebra, the value of money, the orbit and position of the earth and planets, and on tides, gained for him the favour of the government. Queen Ulrica raised the Swedberg family to the rank of nobility in 1719, upon which occasion the name was changed to Swedenborg. In the discharge of the duties of his office he visited, in 1720, the Swedish mines, and in 1721 the Saxon, and wrote some valuable treatises on them. He likewise made similar journeys

to the mines of Austria and Hungary. A work on the origin of things, followed by a treatise on mining and smelting (*Opera Philosophica et Mineralia*), was published in 1734 (8 vols.), and attracted much attention among the scholars of Europe. He was chosen a member of the Academies of Upsala and St. Petersburg. The Academy at Stockholm had already elected him an honorary member in 1729. He increased his stock of knowledge by new travels in 1736-40 in Germany, Holland, France, Italy, and England. The *Economia Regni Animalis* (*Economy of the Soul-kingdom*), published after his return in 1740-41, contains the application of the system of nature, unfolded in his philosophical works, to man. The principle of a necessary creation of all things by a central power is the basis of this system, which is ingeniously unfolded, and illustrates the extent of the author's reading. It is explained in the *Principia Rerum Naturalium*. Swedenborg was first introduced to an intercourse with the spiritual world in detail, according to his own statement, in 1743, at London. The eyes of his inward man, he says, were opened to see heaven, hell, and the world of spirits, in which he conversed, not only with his deceased acquaintances, but with the most distinguished men of antiquity. That he might devote himself more fully to this spiritual intercourse, he resigned, in 1747, his office in the College of Mines which he had hitherto discharged with punctilious exactness, and refused a higher appointment that was offered him. The king still paid him half his salary as a pension. He continued diligent in his attendance at the house of peers, but latterly he resided much in England and Holland. The theological works which he wrote in this period he printed at his own expense. They found but a limited number of readers; and while he was an object of the deepest veneration and wonder to his few followers, his statements were the more mysterious to the rest of the world because he could not be suspected of dishonesty, and exhibited, in other respects, no mental aberration. All respected him as a man of profound learning, an acute thinker, and a virtuous member of society. His moderation and his independent circumstances make it impossible to suppose him actuated by ambitious or interested views; his unfeigned piety gave him the character of a saint, who lived more in the society of angels than of men. In those trances, during which, as he said, he conversed with spirits, received revelations, and had views of the invisible world, he seemed like one in a dream; his features were stamped with pain or rapture, according as heaven or hell was opened to him. In common life he exhibited the refinement of polished society; his conversation was instructive and pleasant; his personal appearance was dignified. Though he was never married, he esteemed the company of intellectual women, and studiously avoided eccentricity. His theological works, which he published anonymously at first, were freely distributed, but in latter years with more reserve; and the mysterious doctrines contained in his writings drew upon him an accusation before the states on the part of the clergy, but without result, as the principal bishops favoured his writings, and he enjoyed the protection of King Adolphus Frederick. With uninterrupted health he attained the age of eighty-four years, and died of apoplexy, at London, March 29, 1772. The doctrines of the New Jerusalem Church are founded on the Bible, as explained in the following works of Swedenborg, written in Latin between the years 1747 and 1771: *Aerona Coelestia*, *De Cælo et Inferno*, *De Telluribus in Universo*, *De Ultimo Judicio*, *De Equo Albo*, *De Nova Hierosolyma et ejus Doctrina Coelesti*, *De Domino*, *De Scriptura Sacra*, *De Vita*, *De Fide*, *De Divino Amore et*

*Divina Sapientia, De Divina Providentia, De Amore Conjugiali, De Commercio Animæ et Corporis, Summaria Expositio Doctrinæ Novæ Ecclesiæ, Apocalypsis Explicata, Apocalypsis Revelata, Vera Christiana Theologia.* Of the Bible, they consider that the Pentateuch, the book of Joshua, the book of Judges, the books of Samuel and of Kings, the Psalms, the Prophets, the Gospels, and the Apocalypse only are the Word of God, and contain an internal sense which they term inspiration. In England, since 1783, they have had chapels in London and in most of the large towns and cities, being especially numerous in Lancashire. The members are as a rule people of the middle and higher ranks. Though they possess a General Conference which meets annually and in which every church is represented by lay members, each congregation is quite free in the administration of its own affairs. The doctrines of the New Jerusalem Church form a very comprehensive scheme, and can only be very briefly and imperfectly indicated here. There is one God, the Lord Jesus Christ, in whom is a Divine Trinity, not of persons but of attributes, the Father answering to the Divine essence, the Son to the Divine manifestation, and the Holy Spirit to the Divine presence everywhere. This Trinity has an analogy in the nature of man, who consists of soul, body, and the activity of both together. All life is of love, and wisdom is the form and manifestation of love. All life is in God, and all who live live in him. Man has a will to be affected by Divine love, and an understanding to be affected by Divine wisdom. In the heavens God appears to the angels as a sun, the spiritual heat from which is love, and the spiritual light wisdom; so that the angels have their hearts filled with love, and their understandings with truth, while at the same time their bodies are warmed and their eyes enlightened by the heat and light of the spiritual sun. The primeval state of man is represented in Scripture by the term Adam. A somewhat similar though inferior state to that of the angels was then enjoyed by him. All natural objects have a spiritual meaning, and this meaning men were permitted to perceive and enjoy. They also perceived and had communication with the angels in heaven. Man being free fell, and his fall consisted in believing in the appearances of the senses rather than the real truths which were in seeming conflict with them, and in acting according to these appearances he gradually removed himself more and more from God, who is the source of life. Thus evil was introduced into the world, and has been transmitted in generation, the spiritual part of the child as well as the natural being derived from the parents. The moral evils to which man is liable are those forbidden in the decalogue. He now inherits tendencies to all those evils, which become sins only when indulged in overt acts, but they must be renounced by repentance and reformation before a heavenly life can be enjoyed. This change is regeneration. Since the fall man has lost all knowledge of the spiritual world by which he is surrounded, but he is still in it and constantly subject to its influence. There are three heavens and three hells, representing various degrees of purity of life and of the opposite condition. The highest heaven is governed by love, primarily to God; the next by truth, manifested in love to one's neighbour; and the lowest by truth shown in simple obedience or from a sense of duty. The three hells represent various degrees of self-love and love of the world, which produce contradiction and strife. In the heavens and hells there are numerous societies, attracted to each other by resemblance, and governed by various principles of usefulness or of selfishness.

Besides these heavens and hells there is an intermediate state called the world of spirits, where man is now as to his soul, which he first consciously enters at death, and in which according to the nature of his ruling love he is prepared for heaven or hell. Angels and devils also operate on the human will, the former inclining it to good and the latter to evil. The devils are not conscious of the influence they exercise on man, but are attracted to his life by the evil that is in it, believing it to be their own. At the time of the advent of Jesus Christ the intermediate state had become so charged with evil influences that the freedom of man's will was in danger of being lost, and the human race of being overwhelmed by evil and destroyed. The work of redemption consisted in casting out the devils and restoring human freedom. The incarnation consisted in Jehovah taking upon himself human nature by means of a human mother, and though 'tempted in all points like as we are,' yet resisting always and thus putting off everything evil and finite. Those who are regenerated attain a similar victory through the influence of the Holy Spirit, which the raising of the humanity of Christ into the Divine nature enables him to communicate to men. There have been various general judgments ending particular dispensations of Divine revelation. The last was in 1757, when the Lord opened the eyes of Swedenborg, and gave him the office of revealing the doctrines of the New Church referred to in the Apocalypse under the figure of the New Jerusalem. As this church is to last for ever, there will be no more general judgments, but each individual will now be judged soon after death. The resurrection is the rising of the soul or spiritual body which takes place at death. The form and sensations of the spiritual body are the same as those of the natural, so that many do not know that they have died and are in the spiritual world. All things take their character from the internal state of the spirit. It is impossible to be in heaven or hell externally as a place without being in it internally as a state. Thus the evils of hell arise from the devils themselves. The devils and angels have all originally been men. God is the perpetual source of life alike to the good and evil, and He rules hell as well as heaven. As the angels desire to do good only they have full play for their natures, but as the devils delight in doing evil they require to be restrained. Those who have their eyes opened can see what goes on in the world of spirits and converse with the spirits, but to seek this intercourse as is done in modern spiritualism is unlawful and highly dangerous.

**SWEDISH TURNIP.** See **TURNIP**.

**SWEET-BAY.** See **LAUREL**.

**SWEET-BREAD.** See **PANCREAS**.

**SWEET-FLAG** (*Acorus Calamus*). This plant is found in marshy places throughout the northern hemisphere. The leaves are all radical, long and narrow, sword-shaped, and somewhat resemble those of the iris; the stem does not differ much in appearance from the leaves, and bears a lateral, dense, greenish spike of flowers, 2 or 3 inches in length; the root is long, cylindrical, and knotted. This plant is referred to the natural order *Acoraceæ*, or *Orontiacæ*. The root has a strong aromatic odour, and a warm, pungent, bitterish taste; the flavour is greatly improved by drying. It has been employed in medicine since the time of Hippocrates; it has sometimes been successfully administered in agues, and as a useful adjunct to other stimulants and bitter tonics.

**SWEET-GUM.** See **LIQUIDAMBAR STRACIPLUA**.

**SWEET-PEA** (*Lathyrus odoratus*), a garden plant belonging to the natural order *Leguminosæ*, and

the sub-order Papilionaceæ. Like the other members of the genus to which it belongs it has compound imparipinnate leaves terminating in a tendril, and axillary peduncles bearing the flowers, which are sweet-scented, and in colour purple, rose, white, or variegated. It is a climbing plant, and grows to the height of about 4 feet. Sicily is said to be its native place.

**SWEET-POTATO** (*Batatas edulis*; natural order Convolvulaceæ). This plant is a native of the East Indies, but is now cultivated in all the warmer parts of the globe, and has produced numerous varieties. Formerly the roots were imported into England from the West Indies by the way of Spain, and sold as a delicacy. It is the potato of Shakspeare and contemporary writers, the common potato having been then scarcely known in Europe. The roots are fleshy and spindle-shaped; the leaves are smooth, varying in form, but usually hastate or three-lobed; the flowers are white externally and purplish within, disposed in clusters upon axillary foot-stalks. In warm climates the culture is very easy, and sweet-potatoes are obtained almost throughout the year by planting at different periods. In northern climates the culture becomes more difficult: but one variety succeeds even in the vicinity of Paris. Considered as an aliment the sweet-potato is nutritious, wholesome, and easy of digestion. The consumption is very considerable, especially in the warmer parts of America, where even several savage tribes have introduced it, on account of its easy culture.

**SWEET-SOP.** See CUSTARD-APPLE.

**SWEET-WILLIAM** (*Dianthus barbatus*; natural order Caryophyllaceæ). This species of pink is an old inhabitant of the flower garden, and has produced numerous varieties; but they have not been named or improved, as the plant has never been treated by florists as a leading flower. It grows wild in dry and sterile places in middle and southern Europe. Its natural colour is rose, or rose streaked with white.

**SWEYN, or SWENO** (properly *Svend*). See DEN-MARK and ÆTHELRED II.

**SWIFT** (*Cypselus*), a genus of Insessorial Birds, generally included in the family Hirundinidæ or Swallows, of which they are made to form a special sub-family (that of the *Cypselinæ*), but by some naturalists considered as more closely allied to the Humming-birds and Goat-suckers. The Swifts differ from the Swallows in having the wings of very long and curved shape. The toes are short and strong, the under toe being in the majority of cases turned forwards with the other toes. The nails are curved and sharp. Like the Swallows, the Swifts possess forked tails. The nostrils are very large, of oblong shape, and are provided with an elevated ridge or margin. The Swifts have, further, a deficiency in the muscles of the lower larynx (see SONG or BIRDS), by which the song-notes are produced. In their active habits these birds perhaps excel even their agile neighbours. The food consists of insects, which they capture on the wing. The Swifts also migrate southwards on the approach of autumn; and in the case of the European Swifts, these birds leave that continent for their winter quarters at a much earlier date than the swallows. The nests are commonly found in the crevices of rocks and in the holes of ruined buildings. The genera included in the sub-family Cypselinæ comprise the genus *Cypselus*, to which the typical Swifts belong. This genus is known by the bill having its sides compressed towards the tip in a very gradual manner, by the nostrils being surrounded with feathers, by the second wing-quill being the longest, by the tarsal being short and feathered to the toes, and by the four toes being all

directed forwards. The Common Swift (*Cypselus apus*) attains an average length of about 7 inches. Its colour is a general sombre or sooty black, a whitish patch appearing beneath the chin. The beak is black, and the 'gape' or opening of the mouth is exceedingly wide, as in most other Fissirostral birds. It occurs very generally distributed throughout Britain, and to ordinary observers is best known by the peculiar swift, shooting flight. It flies abroad chiefly in the morning and evening hours, the insects on which it subsists being then found abroad in greatest plenty. These birds do not appear to keep under cover even in the most stormy weather. The nests are composed of straw, fibres of cloth, and a variety of heterogeneous materials. The Swifts generally build in holes in the roofs of houses, and access to the nest is usually had through a kind of tunnel or road. They may also build in hollow trees, and the eggs, numbering from two to five, are of a white colour. A single brood only is produced each year, and are hatched about the end of June or beginning of July. The Swifts leave Britain about the end of August, but occasionally old Swifts have been known to remain till a much later period in attending to a brood of late hatching. Swifts and Swallows do not appear to associate together in any way, and in flight the separation of these birds is quite apparent. To the genus *Cypselus* also belongs the White-bellied Swift (*C. melba*) or Alpine Swift, as it is also termed, a rare British visitor. The genus *Acanthylis* (represented by the *A. pelagica* or North American Chimney Swift, and by the *A. caudacuta* or Australian Needle-tailed Swift or Swallow), is distinguished by the nostrils being placed in a membranous groove, by the first quill of the wings being the longest, by the tarsi being destitute of feathers and the toes compressed, and by the tail having the shafts of its terminal feathers projecting like so many filaments. The genus *Colloralla*, represented by the various kinds of Esculent Swallows (see SWALLOW), is properly included in the sub-family of the Swifts.

**SWIFT, JONATHAN**, the greatest of English satirists, was the posthumous son of Jonathan Swift, an Englishman, steward of the Irish inns of court, and was born in Dublin, November 30, 1667. He was placed at a school in Kilkenny when six years old, and in his fifteenth year was removed to Trinity College, Dublin, where, applying himself to history and poetry, to the neglect of some of his academical pursuits, he was, at the end of four years, refused the degree of B.A. He was ultimately admitted to this degree *speciali gratia*, which, according to his own account, was equivalent at Trinity College to a discreditable intimation of scholastic insufficiency. But that this insufficiency existed only in some of the departments of academical study is shown by a document (first published in John Forster's unfinished Life) in which Swift is described as a good scholar in Latin and Greek. In his twenty-first year (1688), that is, at the time when Dublin was in the hands of the adherents of James II., he crossed over to England to pay a visit to his mother, who was residing at Leicester, in her native county, in a state of dependence upon her relations. By her advice he was induced to communicate his situation to Sir William Temple, who had married one of her relatives, and who at that time lived in retirement at Moor Park, Surrey. Sir William received him into his house to act as his amanuensis, and in this situation he spent two years. During this period he threw off all his idle habits and did what he could to make up by assiduous study for the time he had lost at Dublin. He was introduced to King William, who often visited Temple privately; and the king, whose feelings were all military, offered him a cap-

talency of horse, which, having already decided for the church, he declined. Being attacked by the disorder which occasioned those fits of vertigo that afflicted him more or less all his life and finally destroyed his reason, he was induced to revisit Ireland, but soon returned, and resided with Sir William Temple as before. Some time after he determined upon graduating as M.A. at Oxford; and having entered at Hart Hall in May, 1692, he received the desired honour in the July following. He was probably indebted to his known connection with Temple for this mark of respect; but it has also been suspected that the words *specialis gratia*, in his Dublin testimonials, were mistaken for a compliment at Oxford. He had certainly not distinguished himself at this time by any public exhibition of talent, although he made some attempts at poetry in the form of odes to his patron and King William. This species of composition being wholly unfitted to his genius, Dryden, a distant relation of his, is said honestly to have told him that he would never be a poet; to which is attributed the extraordinary ranour with which he always alluded to that eminent writer. After residing two years longer with his patron, conceiving the latter to be neglectful of his interest, he parted from him in 1694, with some tokens of displeasure on both sides, and went to Ireland, where he took orders. But he soon returned to Sir William Temple, who, sinking under age and infirmities, required his company more than ever. During the few remaining years of that statesman's life they therefore remained together; and on his death Swift found himself benefited by a pecuniary legacy and the bequest of his papers, which he published with a dedication to the king (three vols. 1700-3), but without any advantage to himself. In 1699 he accepted an invitation from the Earl of Berkeley, one of the lords-justices in Ireland, to accompany him as chaplain and secretary. On the return of that nobleman to England in 1700 he went to reside at the living of Laracor, with which the earl had presented him; and during his residence there he invited to Ireland Miss Esther Johnson, the lady whom he has rendered celebrated by the name of Stella, and with whom he had become acquainted in the house of Sir William Temple, where she resided with her mother, who acted as a companion to Lady Gifford, the sister of Sir William. Miss Johnson, at this time about nineteen years of age, was accompanied by a Mrs. Dingley; and the two ladies resided in the neighbourhood when Swift was at home, and at the parsonage house during his absence. In 1701 he took his doctor's degree, and the same year first entered on the stage as a political writer, by a pamphlet in behalf of the ministers (Whigs) entitled *Contents and Dissensions between the Nobles and Commons of Athens and Rome*—a work of no great force. In 1704 he published anonymously his famous *Tale of a Tub*. This vigorous satire on the Roman Catholics and Dissenters, containing also not a few strokes at the abuses of the Church of England, while it advanced his reputation as a wit, did him no small injury as a divine, being deemed light and indecorous by the functionaries of the church. The *Battle of the Books*, appended to the *Tale of a Tub*, but written before it, is a burlesque comparison between ancient and modern authors, in which he exercises his satire, but with less brilliant success, against Dryden and Bentley. In 1708 appeared his *Sentiments of a Church of England Man in respect to Religion and Government*, Letter concerning the Sacramental Test, Argument against Christianity, and an attack upon astrology under the title of *Predictions for the Year 1708*, by Isaac Bickerstaff, Esq. Of these pieces the first

two expressed sentiments which separated him from the Whigs, and speedily led to his giving his adhesion to the Tories, while the others exhibit that inimitable talent for irony and grave humour which forms his principal distinction. In 1709 he published a Project for the Advancement of Religion, dedicated to Lady Berkeley. This is the only work to which he ever put his name. During part of these two years he was in London, being engaged by the Irish prelaty to obtain a remission of the first-fruits and twentieths, payable by the Irish clergy to the crown. In 1710 he was again in London with the same object, and was introduced to Harley, afterwards Earl of Oxford, and to Secretary St. John, subsequently Lord Bolingbroke. It was at this time that he overtly joined the Tory party, and as that party had just then risen into favour and power the disinterestedness of his motives for doing so has been much questioned. He gained the confidence of the Tory leaders, and making London his fixed place of residence for the time he took a leading share in the famous Tory periodical entitled the *Examiner*. Several political tracts appeared about this time from his pen. The two most famous of these are *The Conduct of the Allies* (1711) and *The Barrier Treaty* (1712), which did immense service to his adopted party, preparing the mind of the country for the peace which the ministers were then anxious to bring about. A bishopric in England was the object of his ambition; but Archbishop Sharpe (the archbishop of York), on the ground, it is said, of his *Tale of a Tub*, having infused into the mind of Queen Anne suspicions of his orthodoxy, the only preferment his ministerial friends could give him was the Irish deanery of St. Patrick's, to which he was presented in 1713. The dissensions between Oxford and Bolingbroke, whom he in vain attempted to reconcile, and the death of the queen, which soon followed, put an end to his prospects, and condemned him to unwilling residence for life in a country which he disliked. He accordingly returned to Dublin, and introduced a meritorious reform into the chapter of St. Patrick's, over which he obtained an authority never before possessed by any one in his station. In 1716 he is said to have been privately married to Miss Johnson; but it is also said that the marriage was consented to by Swift only on the condition that it should be kept secret, and that he and his wife should live in future on precisely the same terms as before the marriage. The fact of the marriage having taken place at all is, however, doubted by Forster. If there is any truth in the story as commonly given one principal reason for these conditions was, no doubt, regard for the feelings of another accomplished lady, Miss Hester Vanhomrigh, his treatment of whom was attended with circumstances still more extraordinary. He became acquainted with this lady in London about 1712; and as she possessed, with a large fortune, a taste for literature, Swift took pleasure in affording her instruction. The pupil became enamoured of her tutor, and even proposed marriage to him; but being probably at that time engaged to Stella, he avoided a decisive answer. That he, however, felt her attractions, seems obvious from his *Cadenus* (anagram of Decanus, dean) and *Vanessa* (Swift's poetical name for Miss Vanhomrigh), the longest and most finished of his poems of fancy. This affair terminated fatally; for discovering his secret union with Stella, the unfortunate lady never recovered the shock, but died a few weeks after, in 1723. She previously cancelled a will she had made in his favour, and left it to her executors (one of whom was the celebrated Bishop Berkeley) to publish her correspondence with Swift, which first appeared in Scott's edition of his works. After re-

siding some time in Ireland without attending to public affairs, in 1730 he was roused by the illiberal manner in which Ireland was governed to publish a Proposal for the Universal Use of Irish Manufactures, which rendered him very popular. His celebrated Letters followed (1733), under the name of M. B. Drapier, in which he ably exposed the job of Wood's patent for a supply of copper coinage, and turned from that to denounce and scourge the abuses of government generally. A large reward was offered for the discovery of the author; but none took place, although it was well known that the letters were the production of the dean, who therefore became the public idol of the Irish people. It was about this time that he composed his famous Gulliver's Travels, which appeared in 1726, exhibiting a singular union of misanthropy, satire, irony, ingenuity, and humour. In this year he made a visit to England, which he repeated in the next year, when he joined Pope in three volumes of miscellanies, leaving the profit to the poet. On the death of George I. he paid his court to the new king and queen. But he was disappointed; and the death in January, 1728, of Stella, who had been long languishing in a state of decline, completed his chagrin. When her health was ruined he offered to acknowledge her as his wife; but she replied, 'It is too late.' He allowed her to make a will in her maiden name, in which she consigned her property to charitable uses. From the death of this injured female his life became much retired, and the austerity of his temper increased. He continued, however, for some years to exercise both his patriotic and his splenetic feelings in various effusions of prose and verse, and was earnest in his exertions to better the condition of the wretched poor of Ireland; in addition to which endeavours he dedicated a third of his income to charity. Some of his most striking poems were written about this time, including his celebrated Verses on his own Death, formed on one of the maxims of Rochefoucault. He kept little company at this advanced period but with inferiors, whom he could treat as he pleased. In 1736 he had a more than usually severe attack of deafness and giddiness. The fate which, owing to his constitutional infirmities, he had always feared, at length reached him; the faculties of his mind decayed before his body, and by 1742 had entirely given way. He died in 1745, in his seventy-eighth year. He bequeathed the greatest part of his fortune to an hospital for lunatics and idiots. The character of Swift is not altogether a pleasing one. His best qualities were his integrity, patriotism, and constancy in friendship, where his friends were really worthy of his regard. He had none of the more genial and amiable virtues, for even his friendship, though sincere, had little tenderness; and he was entirely without delicacy of feeling and elevation of sentiment. His most prominent characteristics were of the more repulsive order, excessive pride, implacability, misanthropy, and general indifference to the feelings of others. On some occasions, too, his conduct exhibited a servility that one would not have expected from the rest of his character; and as we have already seen, even his integrity in politics is not without suspicion. His treatment of Miss Johnson and Miss Vanhomrigh, on the other hand, has often been represented in a more odious light than it deserves to be. It is certainly impossible altogether to excuse it, but the details of his relations with these two women do not justify the charges of heartlessness and cruelty that have been brought against him on their account. There are many evidences of a desire on his part to spare the feelings of both, and in the case of Miss Vanhomrigh it is known that he unsuccessfully endeavoured to bring

about her marriage with somebody else, in order to repair the wrong that he had done her in allowing her to cherish a passion which he could not gratify. It ought also to be mentioned that a plausible explanation has been given by Scott of his treatment of Miss Johnson in the supposition that the bar to the union with her to which he showed so much repugnance was a physical one, which he could not bring himself to acknowledge. As a writer Swift was original, and has, perhaps, never been exceeded in grave irony, which he veils with an air of serious simplicity, admirably calculated to set it off. He also abounds in ludicrous ideas, which often deviate, both in his poetry and prose, into very unpardonable grossness. His style forms the most perfect example of easy familiarity that the language affords; but although admirable for its pureness, clearness, and simplicity, it exhibits none of the glow of genius. The most esteemed edition of his works is that of Sir Walter Scott (nineteen vols., 1814, and again 1824, recently re-edited). Of some of his works, as of Gulliver's Travels, the editions are innumerable. The best account of Swift's life is that by Sir Henry Craik (one vol., 1885).

SWILLY, LOUGH, an arm of the Atlantic which penetrates the county of Donegal in a southerly but somewhat circuitous direction for about 25 miles. It is a fine expanse of great depth, and on its eastern shore, opposite to the town of Buncrana, has a roadstead where the largest men-of-war might anchor in safety. It is not much frequented.

SWIMMING is one of the most important branches of gymnastics. Its effects in developing, invigorating, and giving health to the body are so great, and it is so easily learned, that we may well be surprised to find it so little practised. In climates where the heat of the summer prevents active exercise on the land it is of the highest value. To all the advantages of cold bathing it adds many others: it enables the bather to remain much longer in the water, on account of the exercise which it affords, and thus—in salt water at least—gives more opportunity to invigorate the skin—one of the greatest benefits of frequent salt-water bathing. The exercise greatly strengthens the lower extremities, the abdominal muscles, the muscles of the chest, and the organs of respiration, the spine, neck, and arms. It increases courage, and furnishes an agreeable excitement—the usual attendant of manly and brisk exercise, but peculiarly so of swimming—on account of the mastery which it gives us over an element for which the human structure is but partially fitted. The means which it affords of preserving our lives or those of others in situations of peculiar peril is also a great recommendation of this exercise, which may be easily learned wherever there is water of 5 feet depth. In the article LOCOMOTION (ANIMAL) we have already described the movements that the limbs perform in the different styles of swimming. Want of confidence is the greatest obstacle in the way of most who begin to learn swimming. The beginner cannot persuade himself that the water will support him, and with the feeling that some muscular effort is necessary for the purpose stiffens his back in such a way that the water cannot support him with the head above water. If, instead of doing this, the learner, while throwing himself calmly forwards, would bend the spine downwards in the region of the loins, so as to force the vertebrae of the back and neck carrying the head upwards; if, indeed, he would give up the endeavour to support himself by a muscular strain, and trust to the water to support him like a cushion, the art of swimming would come to him almost as naturally as the art of walking does to a child. When the ability to swim in the ordinary

way, face downwards, is acquired everything is acquired. It is as unnecessary to give special instructions for swimming on the back, on the side, &c., as it is to direct people who are able to walk how to turn themselves or walk up or down hill. Animals, when swimming, do not vary much from their motion in walking; but man is obliged to change his motion entirely. All the Slavonic nations—Russians, Poles, &c.—swim in a way somewhat resembling the motion of dogs in the water, making a separate effort with each of the four extremities. In saving a person from drowning, which can be done most effectually if he has already lost consciousness, pull him by the hair, or push him before you, if far from shore; otherwise take him by the arm. If the person in danger is an exhausted swimmer call to him to be quiet; support him by one shoulder; or, if he still retains his presence of mind, let both his hands rest on your shoulder or under your arm-pits, and let him work slowly with his legs. If the person in danger is not a swimmer, and is struggling, take care not to approach him in front—his convulsive grasp may be fatal to both; but approach him from behind, and if he is sinking take hold of him under the arm-pits and thus support him. If he grasps you so that you are unable to move struggle with him under the water. The drowning person, in this situation, will often let go his hold, striving instinctively to reach the surface; but if the struggle becomes one for life the only mode of making your antagonist relax his hold is said to be to grasp his throat and render him senseless. An excellent method of supporting another in the water is to allow the person supported to rest his hand on your hips. Any swimmer who first tries the experiment will be surprised to find with what ease he can support a person attached to him in this manner. This method can scarcely be practised in cases where persons unable to swim are drowning; but it may be of much avail in supporting a brother swimmer who is attacked with weakness or cramp, and who has presence of mind to take advantage of the support.

Several feats of modern swimming have been placed on record, in which considerable prowess has been evinced. The famous Neapolitan diver generally known by the name of *Il Pesce*, or the fish, is said on one occasion to have performed the distance of 50 miles in twenty-four hours on the coast of Calabria. Lord Byron and a Mr. Ekenhead swam across the Hellespont. But the greatest swimming feat of recent, if not of all times, is that of Captain Webb, who swam across the Straits of Dover, from Dover to Calais, performing the latter part of the exploit in an unfavourable sea. The swimmer started from Dover in the afternoon of the 24th of August, 1875, and reached the opposite coast the following morning, after being twenty-one hours and three-quarters in the water. The direct distance across is 24 miles, but Captain Webb is estimated to have actually swum at least 32 miles, owing to the effect that tides and currents had in driving him out of his direct course. He was none the worse for his extraordinary exertions.

**SWIMMING-BLADDER, AIR-BLADDER, or SOUND** (of fishes), the names applied to a sac or bladder-like structure found in most, but not in all fishes, the office of which consists in altering the specific gravity of the fish, and thus enabling it to rise or sink at will in the surrounding water. It is thus a hydrostatic organ; and when we trace its homology or structural correspondence with the parts of other vertebrates, we find that it is homologous with the *lungs* of higher forms than fishes. It has, however, no *analogy* or *functional* correspondence with the lungs or breathing organs, save in the

peculiar *Lepidosirens* (which see) or Mud-fishes, in which the air-bladder becomes cellular in structure, as will be presently explained, and otherwise assumes a lung-like structure and function. In its simplest condition it exists as a closed sac lying beneath the spine, and containing air or gases of different kinds. By the muscular compression of its walls the density of the contained gas is altered, and the specific gravity of the fish affected accordingly, so as to change its position in the water. In most sea-fishes the gas which the swimming-bladder contains is oxygen, that in the air-sac of fresh-water fishes being mostly nitrogen. Such fishes as the Flat-fishes or *Pleuronectidae* (which see), represented by the *Flounders*, *Soles* (which see), &c., have no swimming-bladder developed, and it may be absent in other forms, such as *Sharks*, *Rays*, *Lampreys*, &c. The simple short and single condition of the swimming-bladder may be altered and modified in various ways. Sometimes the air-sac is divided by septa or partitions into chambers; and in the *Lepidosiren*, and some other fishes this process of internal subdivision proceeds to such an extent that the structure becomes of cellular nature, like the lungs of reptiles and higher forms. In the *Carp*s it exhibits a constriction or narrowing in the middle. In other forms the air-bladder may present a fringed appearance from the development of many lateral processes. In some fishes the air-bladder, instead of being a shut and closed sac, communicates with the gullet by means of a special tube—the *ductus pneumaticus* or *pneumatic duct*. This arrangement is well seen in *Polypterus*, in the *Carp* and in the *Bony Pike* (*Lepidosteus*.) In the *Herring* the pneumatic duct is connected with the cardiac or anterior portion of the stomach. In the *Carp*, further, the swimming-bladder communicates with the internal ear. In the *Cod*, *Perch*, and many other fishes no duct exists. In the *Loach*, as in the *Carp*, the air-sac is connected with the ear, and has probably some auditory function. Tracing the homology of the swimming-bladder through the entire class of fishes, we may thus note its modification from a simple closed sac to a divided cellular organ, as in the *Lepidosiren*, in which the single structure becomes divided into two lung-like bodies, and the pneumatic duct becomes the homologue of the *trachea* (which see) or *windpipe*. In the *Lepidosiren* blood is brought directly for purification to the swimming-bladder, which thus becomes lung-like in function, as well as in structure.

**SWINDON**, a municipal borough of England, in Wiltshire, on the Great Western Railway, 27 miles S.W. of Bath. The borough consists of the former urban districts of Old and New Swindon, which were amalgamated and incorporated in 1900. The old town stands on a hill which commands a fine view over the rich valleys watered by the rivers *Cole* and *Ray*. Besides the churches and places of worship for the various bodies, the town has a town-hall, corn-exchange, mechanics' institute, hospitals, swimming-baths, new town gardens, a theatre, &c. The growth of the town is mainly due to the works of the Great Western Railway Company, in which about 12,000 persons are employed. There are also clothing and boot factories in the town, and quarries near it. Electrical tramways have been introduced. Pop. (1891), 33,001; (1901), 44,996.

**SWINE**. See *HOG*.

**SWINE-FISH**, a name given to the *Anarrhichas lupus* or Sea-wolf (which see).

**SWINEMÜNDE** (that is, 'mouth of the Swine'), a Baltic seaport of Prussia, in the province of Pomerania, and government of Stettin, 36 miles N.W. of the town of Stettin, of which it is the out-port, on the island of Usedom, on one of the mouths of

the Oder. It has spacious well-built streets, is strongly fortified, and has the best Prussian harbour on the Baltic, 26 feet deep at the entrance. It carries on a considerable trade, also shipbuilding and fishing. Swinemünde is much frequented for sea-bathing, and its environs are very attractive. Pop. (1895), 9391.

**SWITHIN**, Sr., an English prelate of the ninth century. He was ordained to the priesthood in 830, was charged with the education of Prince (afterwards King) Alfred, and in 852 was made Bishop of Winchester. He died about ten years later. He was canonized a century later. The popular knowledge of this saint's name is due to the belief that if rain falls on the 15th of July (which is popularly known as St. Swithin's Day) it will rain for six weeks after. This notion is said to have arisen from the fact that when the bones of St. Swithin were about to be removed, after his canonization, from their original resting-place in Winchester churchyard to the interior of the cathedral, their removal, which was to have taken place on the 15th of July, was delayed for forty days by the excessive rains which fell uninterruptedly for that period. Similar superstitions are connected in various conti-

mental countries with other saints' days which occur in summer.

**SWITZERLAND** (German, *Schweiz*; French, *Suisse*), a federal republic of Central Europe, bounded on the north by Baden, from which it is separated for the most part by the Rhine; on the north-east by Württemberg and Bavaria, from which it is separated by the Lake of Constance; on the east by the principality of Lichtenstein and the Tyrol, from the former of which it is separated by the Rhine, and from the latter partly by the Rhine, but chiefly by ranges of the Grison Alps; on the south by Italy, from which it is separated by the Alps and the Lake of Geneva; and on the west and north-west by France, from which it is separated in part by the Jura Mountains and the river Doubs. It thus appears that mountains and rivers inclose the country on almost every side, and define its boundaries by grand natural features. The greatest length of Switzerland, from west to east, is near the parallel of 46° 35', where it is 210 miles; the greatest breadth, measured a little west of the meridian of 9° east, is 123 miles. The federal cantons of which it consists, with their separate areas and populations, are exhibited in the following table:—

Cantons.	Area in sq. m.	Population, 1888.	Population, 1900.	Chief Towns.
Aargau (Fr. Argovie).....	542	193,580	206,460	Aarau or Arau.
Appenzell, Outer Rhodes.....	93	54,109	55,284	Appenzell.
Inner ".....	69	12,888	13,480	Herisau.
Basel (Fr. Bâle), city.....	14	73,740	112,240	Basel.
country.....	163	61,941	68,461	Liesthal.
Berne (Fr. Berne).....	2,059	530,670	587,938	Bern.
Freiburg (Fr. Fribourg).....	644	119,155	127,719	Freiburg.
Gall, St. (Ger. Sankt Gallen).....	770	228,174	250,060	Gall (St.).
Geneva (Fr. Genève; Ger. Genf).....	108	165,509	181,674	Geneva.
Glarus (Fr. Glaris).....	267	33,825	32,397	Glarus.
Grisons (Ger. Graubünden).....	2,753	94,510	104,510	Coire.
Lucerne (Ger. Luzern).....	670	135,300	146,474	Luzern or Lucerne.
Neuchâtel (Ger. Neuenburg).....	312	108,153	125,804	Neuchâtel.
Schaffhausen (Fr. Schaffhouse).....	113	37,783	41,523	Schaffhausen.
Schwyz (Fr. Schwytz).....	350	50,807	55,497	Schwyz.
Solothurn (Fr. Soleure).....	306	85,621	100,838	Solothurn.
Ticino (Ger. and Fr. Tessin).....	1,038	126,761	142,719	Bellinzona.
Thurgau (Fr. Thurgovie).....	381	104,678	113,110	Lugano.
Unterwalden, Upper.....	183	15,043	15,280	Frauenfeld.
Lower ".....	112	12,538	13,088	Sarnen.
Uri.....	415	17,249	19,701	Stanz.
Valais (Ger. Wallis).....	2,026	101,985	114,980	Altorf.
Vaud (Ger. Waadt).....	1,244	247,655	279,152	Sion.
Zug.....	92	23,020	25,045	Lausanne.
Zürich.....	666	337,183	430,336	Zug.
				Zürich.
Total.....	15,958	2,917,764	3,313,817	

**Physical Features.**—These are on the grandest scale, and furnish scenery which, if equalled, is not surpassed in any other part of the globe; lofty mountain ranges towering above the clouds beyond the limits of perpetual snow, enormous glaciers descending from their sides and blocking up the higher valleys; magnificent lakes embosomed among mountains, which often rise sheer from the water's edge for many thousand feet, and wild romantic valleys forming the channels of impetuous streams, fed by numerous torrents and cascades. The loftiest mountain-chains belong to the Alps, and are situated chiefly in the south. The central nucleus is Mount St. Gothard, on the confines of the cantons of Uri and Ticino. This remarkable mass, nearly equidistant from the equator and the pole, unites the principal water-sheds of Europe, and sends its waters into four large basins—north by the Rhine to the German Ocean, south-west by the Rhone to the Mediterranean, south-east by the Po to the Adriatic, and east by the Danube to the Black Sea. In like manner it forms a kind of starting-point for the loftiest ranges of the Alps. It belongs itself to the

Helvetian or Lepontine range, which stretches east from it to Mount St. Bernardin, and south-west to Mount Rosa, from which it is continued west, under the name of the Pennine Alps, to the culminating point of Europe in Mont Blanc, beyond the Swiss frontiers in Savoy. From Mount St. Bernardin the main range of the Alps, belonging to what is called the Rhaetian branch, stretches first east, and then north-east across the canton of Grisons into the Tyrol. To the north of the ranges now described, and nearly parallel to them, two other ranges, setting out as before, proceed, the one the Bernese Alps, south-west between the cantons of Bern and Valais; and the other north-east along the north frontiers of the Grisons, and through the cantons of Uri, Schwyz, Glarus, and St. Gall. These ranges, though possessed of many lofty summits, and exhibiting much magnificent scenery, are much less elevated than the more southern ranges. They throw out numerous ramifications towards the north, but in that direction descend so rapidly that the country almost loses its alpine character, and becomes more hilly than mountainous. Besides the Alps, properly so called, the only range

deserving of notice is that of the Jura, which is linked to the Alps by the Jorat, a small range which stretches west and north-west across the Pays-de-Vaud, and extends in a N.W. direction along the west of the cantons of Geneva, Vaud, and Neuchâtel. See ALPS.

*Rivers and Lakes.*—The Rhone and Rhine both have their sources in the glaciers of Switzerland, and the Danube and the Po are indebted to it for important feeders; but owing to the mountainous nature and inland position of the country none of the rivers acquire so much development within its limits as to become of great navigable importance. The Rhine, formed in the canton of Grisons by the junction of the Vorder and Hinter Rhein, flows north into the Lake of Constance, and then on emerging from the lake flows west to Schaffhausen, where it forms the celebrated falls of that name. Below these falls its navigation properly begins, and is continued west along the frontier to Basel, where a sudden turn north carries it into Germany. Its principal affluent in Switzerland is the Aar, which traverses a large part of the country circuitously from the south of Bern to the north frontier, and is augmented by a great number of important affluents. The Rhone, rising in the glacier of St. Gothard, on the north-east confines of the canton of Valais, receives all the drainage of that canton, flowing through it centrally first W.S.W. and then N.W., till it falls into the Lake of Geneva. Immediately after issuing from the lake at the town of Geneva it receives the Arve, and about 10 miles below quits the Swiss frontier. The waters which the Po receives from Switzerland are carried to it by the Ticino, which drains the canton of that name; those which the Danube receives are carried to it by the Inn, which rises and has a considerable part of its upper course in the east of the canton of Grisons. The whole drainage of Switzerland is thus divided among the three basins of the North Sea, the Mediterranean, including the Adriatic, which is properly only a branch of it, and the Black Sea. The proportions received by each are in the order now stated, but the far largest share belongs to the first. The lakes of Switzerland are more numerous than in any other part of Europe, with the exception of Finland; and both from their individual magnitude, and the lofty mountains among which they are embosomed, often give to the scenery its peculiar charm. Those of Geneva in the south-west, and of Constance in the north-east, the two largest of the whole, as well as that of Maggiore on the south side of the Alps, belong partly to other countries; but within the limits of Switzerland, and not far from its centre, often at short distances from each other, though usually separated by mountain-ranges, lakes stretch across the whole breadth of the country from W.S.W. to E.N.E. Tracing them in this direction, we come successively to Lake Neuchâtel, with Morat and Bienne in its vicinity, Thun with its feeder Brienz, Lucerne or Vierwaldstättersee, Sempach, Baldeg, Zug, Zürich, and Wallenstättersee. All these internal lakes, owing to the superior loftiness of the southern ranges, which gives them no outlet in that direction, discharge themselves by streams which flow north, and consequently belong to the basin of the Rhine.

*Geology and Minerals.*—All the loftiest alpine ranges have a nucleus of granite, on which gneiss and mica-slate recline generally at a high angle. These rocks are particularly developed in St. Bernard, St. Gothard, the Faulhorn, &c., and contain a great number of beautiful minerals, particularly garnets and various kinds of rock-crystals. Syenite is not of frequent occurrence, but is found on the south side of St. Gothard, and on the Finster-Aarhorn. Hornblende

is seen exposed in steep precipices near Saas, in the upper part of the canton of Valais, and forms whole mountains in various parts of the canton of Grisons. In the same locality serpentine is largely developed. Granular limestone is widely diffused throughout the Alps, and is more particularly exposed on the Great and Little St. Bernard, and the south side of St. Gothard. It usually rests on mica-slate, and often alternates with clay-slate and primitive gypsum. Mountain-limestone composes the great masses of the Dent-du-Midi, the Diablerets, the Wetterhorn, Dodi, &c. It is also seen in large masses on the east shore of the Lake of Geneva, on the Moleson, Stockhorn, Pilat, and Santia. Coal-bearing strata are not extensively developed, but are found in the cantons of Valais, Vaud, Freiburg, Bern, and Thurgau, and brown coal is obtained in St. Gall and Zürich. In the Jura, limestone equivalent to the colite, often resting on muschelkalk, is so largely developed, that the name of Jura limestone is now often applied to the whole colitic formation. Above the Jura limestone is the molasse, a soft green sandstone, belonging to the lower series of the tertiary formation, and covering an extensive area in the lower parts of Switzerland. None of the rocks are rich in minerals. Iron is worked to advantage in several quarters, particularly among the strata connected with the Jura limestone. Rock and common salt are produced to some extent in the cantons of Vaud, Basel, and Aargau. The only other minerals deserving of notice are alabaster and marble, widely diffused; and asphalte, in the Val-de-Travers in the canton of Valais. Mineral-springs occur in many quarters.

*Climate.*—The great diversities here observed are evidently caused not by differences of latitude but of elevation. Hence while winter is reigning in all its rigour on the lofty summits or slopes of the mountains it is only necessary to descend into the lower valleys to find that spring is far advanced. According to observations which have long been made with great care at the hospice of St. Gothard, Bern, Zürich, and Geneva, the respective mean temperatures are in winter 17°·94, 29°·37, 30°·34, 33°·35, and in summer 45°·71, 58°·78, 64°·15, and 66°·10. For the purpose of comparison we may mention that the winter temperature of London is 38°·22, and the summer temperature 61°·74. The same causes which thus diversify the climate tend also to make it extremely variable even in the same localities. These sudden changes are very trying to weak constitutions; but the air is clear and bracing, and for the strong eminently favourable to health.

*Vegetation, Agriculture, &c.*—Few countries in Europe even of larger extent can boast of a more varied vegetation than Switzerland. It has been divided into seven regions. The characteristic product of the first is the vine, which grows in all the cantons except Uri and Glarus, where it is not cultivated at all, up to 1700 feet, and in some districts of Zürich and the Lake of Thun to 1800 feet above the sea-level. The next in ascent is the hilly or lower mountain region. It rises to the height of 2300 feet, and is characterized by the luxuriance of its walnut-trees. Though not well adapted for wheat it raises good crops of spelt; and has excellent meadows, from which two cuttings of hay are annually obtained. The third or upper mountain region has its limit at 4100 feet. Its principal product is forest timber, consisting of all varieties of hard wood, but more especially beech. Good crops are obtained in it of barley and oats. The pastures too are excellent. Above this, and up to the height of 5500 feet, is occupied by the fourth or subalpine region, distinguished by its pine forests and maples. Here winter lasts from eight to nine months; no regular crops are

grown, but some kinds of kitchen vegetables are raised, and a few potatoes, generally of small size. Many of the heights are covered with a rich grassy sward. The next two regions are sometimes included under the common name of alpine—the one, lower alpine, terminating at 6500 feet, and the other, upper alpine, ascending to the limit of perpetual snow. The former is the proper region of alpine pastures; the latter as it ascends becomes more and more stunted in its vegetation, and the variation of the seasons is lost, spring and autumn being altogether excluded, and a winter of rigorous severity following close upon a short summer of only five or six weeks. The seventh and last region is that of perpetual snow. Even here vegetation is not utterly extinct, and several varieties of lichens are found clinging to the rocks. Many parts even of the lower regions of Switzerland are of a stony, sterile nature, but on every side the effects of persevering industry are apparent, and no spot that can be turned to good account is left unoccupied. The cantons of Lucerne, Solothurn, Freiburg, and Schaffhausen are the only ones that produce more grain than is required for home consumption; in Aargau and Valais the production meets the home demand but no more; in all other cantons the production is insufficient. The principal grain crops are in the flatter districts spelt, wheat, rye, summer and winter barley, and Turkish corn; in the higher districts summer barley and oats. Hemp and flax are extensively grown on all lands suitable for them, but chiefly in Bern, Aargau, and Thurgau, and nearly supply the whole of the home consumption; maize yields rich crops in the southern valleys; oil and poppy seed are also generally cultivated, and in some of the higher districts caraway forms a favourite crop. Tobacco is chiefly confined to the flatter parts of Freiburg, Ticino, Vaud, Bern, and Grisons. In the same cantons occasional patches of saffron are seen. Besides the ordinary fruits, apricots, peaches, almonds, and figs thrive well in the open air in many of the warmer spots with a southern exposure and northern shelter. More delicate fruits, as oranges, citrons, lemons, and pomegranates, are almost confined to the southern side of the Alps, in the canton of Ticino. There too the olive thrives, and a good deal of silk is obtained by the cultivation of the mulberry. The wine grown in Switzerland is of inferior quality. Timber of all kinds is abundant in most of the cantons, but great waste has been committed, and several of the most accessible forests have been so much thinned that the prospect of an ultimate scarcity in several quarters has begun to cause serious apprehension. Many of the forests it is necessary to preserve as a protection against landslips and avalanches. Among domestic animals the first place belongs to the horned cattle, which are both remarkable for their numbers and the superiority of their breeds. Swiss cows can scarcely be surpassed either in beauty or in the amount of their dairy produce; and the demand for them in other countries has given rise to a very lucrative branch of trade. Great quantities of cheese are made and exported, cheese-making indeed being the most important branch of rural industry. Condensed milk is also exported. Horses attract less attention, and are generally small. Sheep are very much confined to the lower districts, and have not yet attracted much attention except in the cantons of Grisons, Valais, Bern, Vaud, and Geneva. On the higher grounds goats are very numerous, and managing to pick up their subsistence where no other domestic animal could live contribute greatly to the comfort if not to the wealth of their possessors. Among wild animals are bears and wolves, found both in the Alps and Jura; chamois, found chiefly among the loftiest moun-

tains of the Alps; wild boars not uncommon in Bern, Vaud, and Aargau; stags in Bern, and occasionally in the Grisons; badgers, foxes, hares, otters, birds of prey of large dimensions, and many varieties of winged game. The lakes and rivers are well supplied with fish. Bees are reared in several cantons.

*Manufactures and Trade.*—Though the geographical position and the configuration of the surface place Switzerland under considerable disadvantages manufactures of various kinds were established in it at a very early period, and have extended rapidly in recent times in face of the formidable competition to which they are subjected, so that Switzerland now holds for certain articles (cotton fabrics, silk stuffs, watches, and articles in plaited straw) an important place in the great markets of the world. The manufactures of Switzerland are still to a large extent domestic, but there are now numerous industrial establishments, some of them of great size. Cotton-spinning is chiefly carried on in Zürich and Glarus, to a less extent in Aargau, St. Gall, and Zug. Cotton-weaving is spread over all the cantons, but is most actively pursued in St. Gall and Appenzell. A very important branch of this industry is the manufacture of figured muslins. The silk industry, in which Switzerland is surpassed only by France and England, is most largely developed in the towns and cantons of Zürich and Basel. In the making of watches also Great Britain and France are the only rivals of Switzerland, although this industry is confined to a small part of the country, principally to the canton of Geneva and the Jura district. Nearly 50,000 persons are said to be employed in it. The plaiting of straw gives occupation to about 70,000 persons. Its chief seats are the cantons of Aargau, Freiburg, and Tessin. Among the other important manufacturing industries of Switzerland are the making of jewelry (chiefly at Geneva and Lausanne), of musical instruments (organs and pianos at Zürich), the preparation of chocolate (in the French districts), and of spirit of wormwood and cherry water (in Neuchâtel), and the making of various articles in wood. Wood-carving is largely carried on in the Bern highlands. Among exports are manufactured goods, cattle, butter, cheese, condensed milk, &c.; the imports include grain and flour, cotton, silk, sugar, wine, colonial produce, woollens, various articles in metal, &c. Imports in 1900, £48,270,000; exports, £35,400,000. The imports from Britain in 1900 were £2,800,000, the exports thereto £7,020,000. The natural obstacles to trade are great, but the means which have been employed to lessen or remove them are almost as extraordinary as the difficulties, and the great roads which now lead across some of the loftiest passes of the Alps will long be pointed to as among the most remarkable of engineering achievements. Even more wonderful are the tunnels which pass through the Alps, the St. Gothard tunnel, over 9 miles long, being the longest yet completed, and the Simplon tunnel, in course of construction, nearly 13 miles in length, the longest ever undertaken. (See ALPS.) Nor have the ordinary communications of the interior been neglected. In almost every canton, as far as the nature of the surface will admit, the roads are both well made and carefully kept, and in proportion to the area the railway system is considerable. At the end of 1900 there were 2362 miles of railway in operation, constructed at a cost of £50,000,000. In 1898 nationalization of all the railways was decided upon. Though the impetuosity of the rivers greatly limits their navigable importance, and leaves little scope for the construction of extensive canals, many hydraulic works have been executed on a scale of no mean extent considering the limited resources

of the country and the obstacles to be overcome. Among others may be mentioned the two canals of the Linth, one connecting it with the Lake of Wallenstadt and the other connecting it through that lake with the Lake of Zürich. At the end of 1900 the total length of the telegraph lines in Switzerland belonging to the state was 4286 miles, that of the telegraph wires 13,478 miles. This includes all telegraph wires except those used for the railway service. Formerly there existed a great obstacle to trade in the want of uniformity of the monetary systems and of the weights and measures among the different cantons, but this has long been removed by the adoption in all these cases of the French system.

*Church and Education.*—Both the Evangelical-reformed church as modelled by Calvin and Zuinglius and the Roman Catholic are national churches in Switzerland. The organization of the former is synodal and presbyterian; the latter is governed by five bishops. The order of the Jesuits and the societies affiliated to it are not allowed. The Protestants are considerably more numerous than the R. Catholics. Primary education is secular and compulsory throughout the confederation. There are about 6400 primary schools and over 500 secondary schools; while for the higher education there are six universities. The University of Basel dates from the fifteenth century, but the others originated in the nineteenth. They are located in Bern, Zürich, Geneva, Freiburg, and Lausanne. They have the four faculties of theology, law, medicine, and philosophy. Neuchâtel has an academy with faculties of theology, law, and philosophy. The total number of students in the universities and Neuchâtel academy in 1901 was 4199. There are also so-called middle schools, normal schools, and many professional, commercial, and industrial schools, including a famous polytechnic school at Zürich, the organization of which provides for a preliminary course in mathematics and for special training in such departments as the art of construction, engineering, technical mechanics, technical chemistry, agriculture and forestry, paediatrics, political economy, and the military art.

*Government and Finance.*—The cantons of Switzerland—twenty-two in number, three of which are divided so as to form in most respects separate cantons—are united together as a federal republic for mutual defence, but retain their individual independence in regard to all matters of internal administration. By the constitution adopted by the federal diet, September 12, 1848, and modified by a vote of the people on the 18th April, 1874, the legislative power of the confederation belongs to a federal assembly, and the executive power to a federal council. The federal assembly is composed of two divisions—the national council and the council of the states or the senate. The national council is elected every three years by the cantons—one member to each 20,000; but when a surplus of above 10,000 exists an additional member is elected. Every lay Swiss citizen is eligible. Each canton, and when divided each half-canton, is entitled to send one member at least. The senate consists of forty-four members—two for each canton: the half-cantons sending one each. In addition to its legislative functions the federal assembly possesses the exclusive right of concluding treaties of alliance with other countries, declaring war and signing peace, sanctioning the cantonal constitutions, and taking measures regarding neutrality and intervention. Federal laws and resolutions not urgent must, on the demand of 50,000 citizens or eight cantons, be submitted to a vote of the people. The members of the federal council are

nominated for three years by the united chambers in the federal assembly from those citizens who are eligible to the national council, to the number of not more than one for each canton. The functions for each council are distributed among seven departments. No member of one of these bodies can at the same time be a member of any of the others, and no member of the federal council is allowed to have any other employment either in the service of the confederation or of any of the cantons, or to have any other calling or profession. The federal tribunal, consisting of fourteen members, elected for a term of six years by the federal assembly, decides in the last instance in civil causes between the cantons, or between them and the confederation; also between the confederation or cantons on the one part and corporations or individuals on the other. For the administration of criminal law it is divided into the chamber of accusation, the chamber of criminal affairs, federal penal court, and the court of cassation. Each of these sections is composed of three members, and the remaining two members are the president and vice-president of the whole tribunal, and are elected as such by the federal assembly. The city of Bern is the seat of the federal council and of most of the central administrative authorities, but the federal tribunal has its seat at Lausanne. The finance of the Swiss confederation, which is based on the principle of free-trade, is in a flourishing condition. In recent years the revenue has usually amounted to over £4,000,000. For 1902 the estimated revenue was £4,090,000, and the estimated expenditure £4,320,000. The chief sources of revenue are customs and posts and telegraphs. The public debt amounts to nearly £4,000,000. Each canton has, besides, a budget of its own.

*Army.*—The army consists of two divisions. The first is the regular army (Bundesauszug), composed of men from the commencement of their twentieth to the end of their thirty-second year; and the second the Landwehr, composed of men from the commencement of their thirty-third to the end of their forty-fourth year. The strength of the Swiss army in 1901 was as follows: the Auszug, or regular army, 151,766 men, including 114,843 infantry, 4641 cavalry, 20,113 artillery, 5507 engineers, besides sanitary and administrative troops, &c., comprising all men able to bear arms from the age of twenty to thirty-two; the Landwehr (first ban), 63,734 men, from the age of thirty-three to forty; the Landwehr (second ban), 24,209, from forty to forty-four; and the Landsturm, 278,556, only called out in time of war, consisting of all not otherwise in service between the age of seventeen and fifty; total, 518,265 men. The republic is divided into eight divisional army districts, and the regular army is grouped in four army-corps, each of two divisions, a division being assigned for recruitment to each district. Children are instructed in the use of arms at school from the age of eight. For the training of officers there is a central military school at Thun, near Bern. There are, in addition, special training schools for the special branches of the service, especially the artillery and sharpshooters.

*People.*—The Swiss are a mixed people as to race and language. German, French, Italian, and a corrupt kind of Latin called Rhetian or Rumonah (the latter the native name), are spoken in different parts of the confederation. German is the sole language in fourteen cantons—Zürich, Lucerne, Uri, Schwyz, Unterwalden, Glarus, Zug, Basel, Solothurn, Schaffhausen, Appenzell, St. Gall, Aargau, and Thurgau; French in Val d'Anniviers, Neuchâtel, and Geneva; and Italian in Ticino. In Bern, Freiburg, and Valais German and French are spoken, and in Grisons Ger-

man, Rhetian, and Italian. The dialect of French that is spoken by the uneducated in Western Switzerland is called *Romand*, and contains a large number of old French words. But the Swiss have lived so long in a state of confederation that, apart from these peculiarities of origin and language, they have acquired a decided national character, and may now be viewed as forming a single people. Thus viewed they are hardy, active, industrious, temperate, brave, patriotic, well educated, moral, and religious, and in all these respects will not lose by a comparison with any people in the world. They are not, however, without their faults. One of the most prominent of these is their excessive love of money. This makes them selfish and mercenary, and unscrupulous as to the mode of life which they pursue, provided money can be made by it. Hence, notwithstanding their remarkable love of freedom, they are anxious to hire themselves out in menial capacities which are usually supposed to be least compatible with the enjoyment of it, and are ready to enlist in the service of any foreign power with perfect indifference as to the justice or injustice of the cause in which they may be required to spend their blood. While thus engaged the only virtue on which they pique themselves is fidelity to their pay-master. Even at the present day, in spite of laws against recruiting for foreign powers in Switzerland, the number of Swiss troops in foreign service, especially in the Dutch East Indies, is considerable.

*History.*—The lake-dwellings of Switzerland probably furnish us with the earliest indications of the inhabitants of the country. The date of these structures is unknown, but if it is correct to assume that they have come down to us from a period earlier than the first mention of Switzerland or its inhabitants in written history they make it likely that before that time Switzerland was inhabited by a people sufficiently advanced in civilization to carry on agriculture and certain manufactures. (See LAKE-DWELLINGS.) The oldest inhabitants mentioned in written history are the *Helvetians*, a Celtic people who occupied the west of the country from Mount Jura, the Lake of Constance, and the Rhine to the Lake of Geneva and the Rhone. Between 58 B.C. and 10 A.D. this people was subjugated by the Romans, under whom their territory formed part of *Gallia Belgica* (according to Pliny), and afterwards part of *Maxima Sequanorum*. (See *HELVETII*.) Before the fall of the Roman Empire in the West the northern and largest part of Switzerland was occupied by the German confederation of the *Alemanni*, who introduced their manners and language. Smaller portions of the country fell to the *Burgundians* and the *Lombards*. Christianity had already been introduced from Italy, and as early as the fourth century there were Christian churches at Geneva, Coire, and other places. In the last decade of the fifth century the *Alemanni* were defeated by *Clovis*, king of the *Franks*, and compelled to recognize the Frankish supremacy; and by the year 534, under the successors of *Clovis*, all Switzerland had become a portion of the Frankish Empire. (See *FRANCE*.) The country, however, retained its ancient constitution; the Romans and the old inhabitants were governed by Roman, the *Alemanni* by *Alemannic* laws; and each of the other nations by its peculiar code. The Christian religion was restored anew, and the desolated fields were again brought under cultivation. *Charlemagne* encouraged the arts and sciences in this as in other parts of his dominions, but under his feeble successors the counts or local governors became more and more independent of the royal authority, and finally made the possession of their *Gaus* (districts) hereditary. By the partition of

Verdun, which eventually led to the formation of the German Empire and the Kingdom of France, Switzerland was divided between *Louis of Bavaria*, who got the eastern portion, and *Lothaire*, who got the western (843). The eastern part of Switzerland is thus to be considered as belonging from this date to Germany, to which the western part also ultimately fell. In this part *Rodolph*, one of the local governors, succeeded in 888 in establishing a new kingdom (the Kingdom of Upper Burgundy), extending from the Mountains of Jura to the *Reuss*, and this kingdom, along with Lower Burgundy, which was united to it about 980, was bequeathed by the last sovereign, *Rodolph III.*, in 1032, to the German emperor, *Conrad II.* But for the most part the dependence of Switzerland on Germany was merely nominal. The counts conducted themselves as princes, assumed the name of their castles, and compelled the free inhabitants of their *Gaus* to acknowledge them as their lords. Hence arose a multitude of independent and complicated governments, whose chiefs were engaged in continual feuds with each other. War was the business of the nobles, and misery the fate of the people in the distracted land. This state of matters was first effectually remedied in the reign of *Henry IV.*, who about the end of the eleventh century gave to the Duke of *Zähringen* the north-eastern part of Switzerland. This was the foundation of a power which soon extended over almost the whole of Switzerland. The dukes of *Zähringen* humbled the proud and quarrelsome nobility; favoured *Zürich* and the other imperial cities; and built several new cities, among which were *Freiburg*, *Neuchâtel*, *Bern*, and *Yverdon*. The country people became more secure; the feuds among the nobility less frequent; manufactures and industry flourished; Geneva and *Lausanne*, among the *Romanic*, and *Zürich* and *Basel* among the *German* cities, became thriving towns. After the death of *Berthold V.*, last duke of *Zähringen*, in 1218, affairs in Switzerland became as bad as before. From this time the *Hapsburgs* in the north, and the counts of *Savoy* in the south-west, grew more and more powerful. The emperors were no longer able to afford protection; might gave right, and the boldest became the mightiest.

About this time the history of Switzerland begins to concentrate itself in that of the three forest cantons (*Waldstätte*) of *Uri*, *Schwyz*, and *Unterwalden*, which now gave tokens of those aspirations after freedom which resulted in the foundation of the present confederacy. All three were at the beginning of the thirteenth century subject to the counts of *Hapsburg*, who, although they were properly only imperial bailiffs (*Vögte*), yet regarded themselves, and desired to have themselves regarded, as sovereign rulers. This claim the three cantons constantly refused to admit, and the *Hapsburgs* to make good, and either side took advantage of any political event in the great world that might help to advance their cause. About 1282 the house of *Hapsburg* was divided into two branches, the *Albertine* and the *Rudolfine* or *Laufenburg* line. To the latter fell, among other districts, *Schwyz* and *Uri*; and *Rudolf*, its head, being *Guelph* in his politics, was opposed to the emperor, at that time *Frederick II.* In consequence of this *Rudolf* was deprived by *Henry*, the son of *Frederick*, of his jurisdiction over *Uri*, and this canton was placed immediately under the authority of the empire. This was a great accession of freedom to the people of *Uri*, who had much less reason to dread encroachments on the part of the empire, which could exert but little authority over them, than on the part of powerful neighbours such as the counts of *Hapsburg*. The inhabitants of *Schwyz* were thereby led to desire a similar political

position for themselves, and with that object sent envoys to Frederick, who granted them, according to their request, a charter of liberty, placing them under the immediate protection of the empire, and promising never to permit them to be severed from that connection (1240). As long as the Ghibelline or imperial party remained in the ascendant the Schwyzers continued their efforts to place their freedom on a solid basis; yet after no long time, probably after the death of Frederick in 1250, they were compelled again to recognize the authority of the Hapsburgs. The hope of ultimate success in their struggles for freedom became still fainter when in 1273 Count Eberhard, belonging to the Hapsburg-Laufenburg line, sold Schwyz, along with many others of his possessions, to his cousin Rudolf, of the Albertine line, who in the same year became emperor. During the interregnum in the empire, which had existed from 1256 to 1273, even the people of Uri had allowed to this Rudolf the supreme jurisdiction in their land; but they regarded him only as a governor voluntarily chosen by themselves, not as exercising that authority in virtue of any hereditary claim. This position of Uri, as immediately under the empire, was recognized by Rudolf even after he had become emperor. To Schwyz also he allowed a considerable degree of independence, but he did not recognize it as legally on the same footing with Uri, and the charter which it had obtained from Frederick he did not confirm. After the death of Rudolf the menacing situation of affairs in the empire induced the forest cantons to form their first league (1291). Uri, Schwyz, and Nidwalden (or Lower Unterwalden) then engaged upon oath to support one another against any aggressor. This union undoubtedly aimed at the complete separation of the cantons from the house of Hapsburg; and when Albert, the son of Rudolph, and Adolph of Nassau were contending against one another for the empire, the people of Uri and Schwyz found an opportunity of having their former privileges renewed. Adolph of Nassau, who for a time carried the day against Albert, was readily induced to grant to both charters of freedom similar to those that had been conferred by Frederick II. The battle of Gölleheim, which in 1298 secured the empire to Albert, restored the old position of affairs, although the emperor made no alteration in the arrangements then subsisting in the cantons. It is certain, however, that he confirmed neither the charter of Uri nor Schwyz. Swiss historians charge Albert himself with various usurpations, and his deputies (of whom Gessler is said to have been one—see TELL) with insolence and tyranny; but the accounts of oppression and outrage that have been related of them seem to be greatly exaggerated. The cantons, however, were determined not to submit to the pretensions of the house of Hapsburg, now the house of Austria. Tradition says that on the night of Nov. 7, 1307, thirty-three representatives, with Furst of Uri, Stauffacher of Schwyz, and Arnold of Melchthal in Unterwalden at their head, met at Rütli, a solitary spot on the Lake of Lucerne, swore to maintain their ancient independence, and projected a rising of these cantons for the 1st of January, 1308. On the day fixed the rising actually took place. The Austrian governors were deposed and expelled, and the castles built to overawe the country destroyed. (It is to this epoch in Swiss history, perhaps itself legendary, that the celebrated legend of William Tell belongs. See TELL.) These cantons, however, did not seek to dissolve their connection with the empire. From the continuance of this relation they hoped to derive various advantages, while they had nothing to apprehend from it for their liberties. Accordingly when Albert (who was

assassinated just about the time when the event just recorded occurred) was succeeded by Henry VII. of Luxemburg, they did not delay to seek from him the confirmation of the position they claimed as being under the immediate rule of the empire. This was at once granted, and the house of Austria was not then in a position to regain their lost privileges by force. Yet it was not disposed at once to relinquish its claims, and endeavoured to bring about a settlement of the question in a peaceful way. Eventually a promise was obtained from the emperor to submit the matter to a judicial investigation; but, owing to the sudden death of the emperor in 1313, this promise was never fulfilled. The succession to the empire was now again disputed between a Hapsburg, Frederick III., and a member of another house, Louis of Bavaria; and, as before, the Swiss cantons sought to advance their own interests by joining the party opposed to the Hapsburgs. Their country was then invaded by Leopold, the brother of Frederick; but the signal victory which they gained over the invader at the pass of Morgarten on the 15th of November, 1315, secured their independence. In the same year a perpetual league was made at Brunnen between the cantons. In 1316 Louis of Bavaria confirmed the previous charters of liberty, and in 1318 peace was concluded with the Hapsburgs when their independence was acknowledged. In process of time the three forest cantons were joined by the cities of Lucerne (1332) and Zürich (1351), the cantons of Glarus and Zug (1352), and the city of Berne (1353); and these, with the three original cantons, formed the eight old members, as they were afterwards called, because no additional member was admitted to complete federation till 1481. Over three of the newly-added members, the city of Lucerne and the cantons of Glarus and Zug, Austria had jurisdictional rights similar to those which it had formerly had over the three original cantons, and although these rights of Austria were expressly recognized when they entered the confederation, yet they were practically set aside. This was the cause of hostilities being renewed between Austria and the confederation. For many years Austria waited for what it thought a favourable opportunity of enforcing its claims, and it was not till 1386 that the territory of the confederation was again invaded. In that year Leopold III. of Austria was completely defeated at Sempach (where Arnold of Winkelried is said to have sacrificed his life for the sake of his fellow-countrymen); and when the Austrians were again defeated in 1388 at Näfels, they gave up the struggle, and in the following year agreed to a peace in which the independence of all the members of the confederation was recognized. But these successes now began to have an injurious effect on the spirit of the people, inspiring them with the love of conquest and plunder. Hitherto the individual confederate states had sought to increase their territory in a peaceful way, buying up the foreign possessions that happened to be within their boundaries, and conferring on the inhabitants of the districts thus acquired equal privileges with themselves. Now, however, they began to extend their limits by force, and the added districts, whether conquered by the separate cantons or by all in common, were governed as subject lands. The principal of the joint conquests was Aargau, which was wrested from the Austrians in 1415. Disputes also arose among the confederates themselves, so that Zürich in a war with Austria fell away for a time (1440-50) from the confederation. Its immediate quarrel was with Schwyz, but all the other cantons sided with Schwyz and adopted its colours (white and red). It was from this circumstance that the name of Schwyzers

(Swiss) became extended to the whole confederation. In the war with Austria above referred to there took place the celebrated battle of St. Jacob on the Birs near Basel, where 1600 Swiss were slaughtered almost to a man after offering a desperate resistance to 20,000 French troops, whom the Austrian duke (the Emperor Frederick IV. or III.) had called to his aid (August 24, 1444). Although the Swiss were defeated, the French were glad to conclude a peace and withdraw their forces; and in 1460 the war with Austria terminated in favour of the confederation, which obtained Thurgau. Austria was thus deprived of all its possessions in the regions over which Switzerland now extends. In 1474 a 'perpetual pacification' was brought about between the confederation and Austria through the mediation of Louis XI. of France, who wished to have both powers as allies against Charles of Burgundy. At the instigation of Louis the Swiss invaded Burgundy in the same year, and defeated the army of Charles near Héricourt. Charles himself was at that time occupied in other quarters, but determined at the earliest opportunity to have his revenge. In 1476 he made preparations for invading Switzerland, and although by this time the Swiss had repented of their alliance with France, he would listen to no terms of peace. But the Swiss were again completely victorious, and inflicted severe defeats upon the Burgundians at Granson in Vaud and Murten (Morat) in Freiburg in 1476, and Nancy in 1477. In the last battle Charles was slain. On this occasion the confederates reaped the fruits of victory with moderation. They restored to Savoy the greater part of Vaud, refused the offer of Franche-Comté to join the confederation, and restored his land to the Duke of Lorraine, who had been despoiled of it by Charles of Burgundy. Yet not long after (in 1481) they admitted Freiburg and Solothurn into the confederation, and about the same time they concluded defensive alliances with several of the neighbouring states, by which the latter secured to themselves all the advantage of their powerful protection. Their prosperity rose to such a height that all the courts around, even Austria, sought their friendship and alliance. Strong contingents of troops were sent to the aid of those who gained their favour, and France, the pope, and Venice vied with one another in the sums they expended with this object. Patriots indeed were not wanting who cried out against this abuse, but their appeals and warnings were not sufficient to check it. What was still worse, jealousy between the various towns and cantons, and between the rich and poor citizens of the same town, began to undermine the unity on which the strength and prosperity of the confederation depended. Fortunately for their internal quiet the cantons soon became again involved in a foreign war. The Emperor Maximilian I. of Austria had conceived the design of drawing closer the bonds of the German Empire, and re-establishing order within it. With this end he divided it into circles, in which Switzerland was to be included; erected a supreme court of justice, which was to administer the law for Switzerland as well as for other parts of the empire; required the Swiss to join the Suiabian League; and fixed an imperial 'matriculation,' according to which all the constituents of the empire, including the Swiss, were to contribute money and troops for the Turkish wars. But the Swiss, who had not looked to the empire for protection for 200 years back, and were full of confidence in themselves, and distrust of all that proceeded from the house of Austria, steadfastly refused to listen to any of these demands. The emperor, with the Suiabian League, accordingly declared war against them (1498), and attacked them on all their

frontiers from the Engadine to Basel. The Swiss had to undergo a severe struggle, but, victors in six sanguinary battles, they were, in the Peace of Basel in 1499, freed from the jurisdiction of the imperial chamber, and afterwards from the imperial matriculation; and they were not included in any of the circles of the empire.

From this peace may be dated the definitive separation of Switzerland from the empire. Old forms derived from that connection were indeed still retained. At the accession of new emperors down to Maximilian II. (1564) the cantons applied for the confirmation of their ancient rights and liberties, and the emperor on his journeys into Switzerland was received as such; but after the Peace of Basel there is nothing to show that the empire exercised the slightest influence on the internal or external affairs of Switzerland. The formal recognition of the confederation in the Peace of Westphalia in 1648 can accordingly be regarded only as an international acknowledgment of what had already long existed in fact. In 1501 Basel and Schaffhausen, and in 1513 Appenzell (which had long been an ally), were admitted into full federation. The number of the cantons was thus brought up to thirteen, at which it remained till 1798. The town and the abbot of St. Gall and the town of Bienne had seats and votes in the diet without being in full federation; and there were besides six allies of the confederation not enjoying these privileges—the Grisons, Valais, Geneva, Neuchâtel, Mühlhausen, and the bishopric of Basel.

After the last war the Swiss had no longer any enemy to fear, and their next wars were waged on behalf of foreign powers. In 1512 they conquered for Maximilian Sforza the whole of Lombardy, and in 1513 defeated the French at Novara. In 1515 they were in their turn defeated by the French at Marignano, after which, in 1516, they concluded with France an advantageous peace, known as the perpetual alliance, in which France gave up to Switzerland the whole of the present canton of Ticino, and made several other concessions to it. This perpetual alliance was never broken by France till 1798, and on the side of Switzerland has always been faithfully observed. On several subsequent occasions the Swiss aided France in defending Lombardy, but these expeditions brought them so little profit that they at last became wearied of such services. After 1526 they ceased to enter the field for other powers with whole armies, and contented themselves with concluding capitulations for single regiments and troops of volunteers.

About this time the Reformation began to make its way into Switzerland. Zuinglius at Einsiedeln, in 1518, preached against indulgences, as Luther had done in 1517. In the same year he removed to Zürich, where he began to speak out more openly for reform. Gradually, by his labours and those of Oecolampadius, the principles of the Reformation were diffused through Zürich, Bern, Schaffhausen, Basel, St. Gall, Mühlhausen, and Bienne. Religious jealousy then separated the reformed and the Catholic cantons. (See REFORMED CHURCH.) In Glarus, Appenzell, and the Grisons the people were divided between the two confessions. Lucerne, Uri, Schwyz, Unterwalden, Zug, Freiburg, and Solothurn adhered to the ancient faith; as did likewise the Valais and the Italian balliwicks. Fanaticism kindled a civil war. The troops of Zürich were routed by those of the Catholic cantons at Cappel (1531), where Zuinglius fell, and at the mountain of Zug. In the end, however, the Catholics, after their defeat in 1532, were compelled to make various concessions to the adherents of the reformed faith, and among other

things to give up to them several of the districts held in common by the confederation. In the meantime Savoy, which had long possessed episcopal and seigniorial rights in Geneva, reduced the city to entire submission. But the oppressive manner in which the ducal authority was exercised led Geneva, in 1528, to join Bern and Freiburg. The duke was forced to yield. Bern and Geneva concluded the perpetual league of 1581, and Bern gained possession of the Pays de Vaud. At the same time the reformed doctrines were propagated from Geneva by Calvin. By the Peace of Lausanne, in 1564, Savoy first renounced her claims upon the Pays de Vaud, and was thus driven from Helvetia, as Hapsburg had been before. About this time (1555) Bern and Freiburg divided between themselves the territories of the counts of Gruyeres, so that, in all Helvetia, no great family of the ancient nobles retained its patrimonial estates except that of Neuburg. The Swiss, however, were distracted by religious and political controversies. Aristocracy and democracy, Protestantism and Catholicism, struggled for the superiority. In the Thirty Years' war the confederates maintained a prudent neutrality. In the beginning of the war they were unable to prevent various bodies of troops, favoured by the Catholic cantons, passing through their territory; but latterly, by a well organized system of frontier defence, they managed to preserve the neutrality of their territory, which was not violated from 1640 to 1798. In 1653 there was a general rising of the Protestants in Switzerland, but they were defeated at Willmergen. In 1663 France renewed her alliance with the Swiss, and asserted that they had no right to form alliances with other powers. During the persecution of the Protestants in France (from 1685), to whom they readily gave an asylum and pecuniary aid, they paid as little regard to the remonstrances of Louis, who viewed the reformers as rebels, as he did to the intercession of the Protestant Swiss cantons in favour of their brethren in the faith. The Swiss had little influence in foreign politics during the eighteenth century; and until towards its close they suffered little from foreign interference. Internal dissensions were, however, not yet at an end. In 1712 there was another struggle between Catholics and Protestants, and again a battle fought at Willmergen. On this occasion the Protestants were victorious, and in the same year an advantageous peace for the victors was concluded at the diet of Aarau. The period of tranquillity that followed was alike favourable to the progress of commerce, agriculture, and manufactures, and to the arts and sciences. In almost every department of human knowledge the Swiss of the eighteenth century, both at home and abroad, acquired distinguished reputation, as the names of Haller, Bonnet, Bernoulli, J. J. Rousseau, Lavater, Bodmer, Breitinger, Gessner, Sulzer, Hirzel, Fussli, Hottinger, Johann von Müller, Pestalozzi, and many others witness. The people of the democratic cantons enjoyed an almost unlimited freedom, and took a large share in the affairs of government. Those places which were under the general protection of the whole confederacy were not burdened by excessive taxes; they enjoyed a high degree of civil freedom. The larger cantons, as Bern and Zürich, in which the government was administered by the capitals, or by a body of the citizens, who enjoyed many peculiar privileges, were also in a flourishing condition. Almost everywhere the government was conscientiously conducted, the administration of justice was cheap and simple. Yet discontent still continued to prevail in large sections of the population, and was not altogether without grounds. At the time of the outbreak of the French revolution the whole popula-

tion of Switzerland, with the exception of the capital cities and some municipal towns, and of the anciently emancipated peasantry in the small democratic cantons, consisted of subjects who were shut out from all share in the government; and although these were, as already stated, for the most part well treated, this was not everywhere the case, and even where they had no reason to complain of tyrannical usage they were dissatisfied with the absence of political rights. The example of France at the time of the revolution caused this feeling of discontent to break out in widespread commotions, which ultimately afforded France a pretext for interference. In 1798 the Directory, which then held the executive power in that country, taking advantage of an insurrection against Bern then going on in Vaud, introduced French troops into that region under the title of liberators. All the subject populations of the thirteen cantons now declared themselves free. Bern fell into the hands of the French. The ancient confederation was dissolved; and Switzerland, under the name of Helvetia, was erected into a republic divided into eighteen equal cantons. Geneva, Neuchâtel, the Bishopric of Basel, and Mühlhausen were annexed to the French Republic. In the years immediately following (1799 to 1801) Switzerland was the theatre of the wars between the French, Austrians, and Russians. During this period there was little opportunity for the Swiss to manifest any opposition to the new arrangements; but when the foreign armies left the country a civil war broke out, the emancipated populations naturally preferring the new constitution, while the old cantons refused to accept it. In September, 1802, Napoleon Bonaparte, then first consul of France, offered to the cantons his mediation; but the small cantons, guided by Aloys Reding and Hirzel of Zürich, persevered in their opposition. 12,000 French troops entered Switzerland under Ney, and the diet separated. Reding and Hirzel were imprisoned. In December both parties sent deputies of the eighteen cantons to Paris, to whom Bonaparte transmitted the act of mediation of February 19, 1803, restoring the cantonal system, but granting freedom to the former subjects of the cantons. The cantons were now nineteen in number—*Aargau*, Appenzell, Basel, Bern, Freiburg, Glarus, *Grisons*, Lucerne, *St. Gall*, Schaffhausen, Schwyz, Soleure, *Ticino*, *Thurgau*, Unterwalden, Uri, *Pays de Vaud*, Zug, and Zürich. Those in italics were now admitted for the first time.

Napoleon assumed the title of 'mediator of Switzerland'; and the military service required of the Swiss became more and more oppressive. It was only by great firmness and the sacrifice of immense sums of money that most of the cantonal governments could avert greater oppression: they were obliged to adopt the continental system; and the canton of Ticino was long garrisoned by French troops. In 1813, when the theatre of war approached Switzerland, France permitted the Swiss to maintain their neutrality; but the allies expressed themselves ambiguously, and large armies were soon marched through the country in various directions to France. Their arrival excited a fermentation in many quarters. The act of mediation was annulled December 29, 1813, at Zürich, and several cantons, of which Bern (1814) was the first, laboured to revive their old constitutions. Through the influence of the allied monarchs the cantons were finally prevailed on to assemble a general council; but revolutions and counter-revolutions agitated several of the cantons. Some of them were in arms against each other; others enjoyed a happy tranquillity and the respect of the foreign powers. All, meanwhile, were engaged in settling their constitutions. The old cantons adhered more or less closely

to their former constitutions, and the new cantons endeavoured to give to those which they adopted more stability. A diet was at length assembled at Zürich, and new articles of confederation were agreed upon by nineteen cantons, September 18, 1814. This confederacy was acknowledged by the Congress of Vienna. The Bishopric of Basel, with Bienna, was given to the canton of Bern, excepting the district of Birsack, which fell to Basel, and a small portion which fell to Neuchâtel. Neuchâtel, still remaining a principality subject to the King of Prussia, to whom it had belonged, except from 1806 to 1814, since 1707, Geneva, and Valais were admitted into the confederacy, and the number of the cantons was thus brought up to twenty-two. August 7, 1815, the compact of Zürich was publicly and solemnly adopted, after the deputies of the confederacy at Vienna had given in their accession to the acts of the Congress of Vienna so far as they related to Switzerland. November 20, 1815, the eight powers, Austria, Russia, France, Britain, Prussia, Spain, Portugal, and Sweden proclaimed, by a separate act, the perpetual neutrality of Switzerland, and the inviolability of its soil. Soon after Switzerland became a member of the holy alliance. But the political state of the Swiss cantons, as settled by the Congress of Vienna, and jealously watched by the holy alliance, gave rise to much disaffection in the great body of the people. Though republics in name, nothing could be less republican than many of their laws and customs; privileges of orders, of corporations, of localities, and of family interfered with the equal rights of the majority of the citizens. The federal diet was overawed by the holy alliance, and oppressed, in turn, the cantons; the chief towns tyrannized over the country districts, and a few trades or families tyrannized over the towns. Refugees for political offences from the neighbouring states were refused an asylum, and the press was shackled by the federal diet, in opposition to the voice of the nation, and in compliance with the demands of the great powers. In the democratic cantons, in which the people were not oppressed by their cantonal authorities, they were often disgusted with these servile compliances of the diet; but in the aristocratical cantons, in which almost all the authority was in the hands of some patrician families, or the corporations of the trades, it was often abused to oppress the mass of the people. This was particularly the case in Bern, Basel, Freiburg, Lucerne, Zürich, Schaffhausen, and Solothurn. Still a third class of cantons was composed of the new members of the confederacy, professedly organized on popular representative principles, but in which, in 1815, the elections were so arranged that the whole power, in fact, was possessed by a small executive council. In this state of things the general demand for reform in the electoral assemblies of Ticino compelled the council (June, 1830) to yield to the public voice, and establish a system of direct elections, and of publicity of proceedings in the great council, and to guarantee the liberty of the press and the inviolability of persons, as parts of the constitution. This event, and the French revolution of July, 1830, set the example for general risings in various parts of the country. After considerable agitation had taken place, and some open outbreaks, the federal diet decided, July 17, 1832, to submit the pact of 1815 to a revision. This decision, after a number of cantonal changes had occurred, was renewed August 16, 1847. After many discussions and hesitations a new federal compact was agreed to by a majority of deputies of nineteen cantons, September 12, 1848. The cantons which then held out were Uri, Schwyz, and Unterwalden. In 1846 these cantons, along with Lucerne,

part of Freiburg, Zug, and Valais had formed the League of the Sonderbund, an ultra Roman Catholic element being at the bottom of the anti-federative feeling. The determination of the majority of the cantons to maintain the federation intact, on principles heretofore subscribed to by all, led to a civil war, which was terminated by the triumph of the federative forces sent against the malcontent cantons in the autumn of 1847. During the commotions of 1848 Neuchâtel set aside its monarchical form of government and adopted a republican one, which was recognized by the confederation in spite of the protests of the Prussian king. For some time there appeared to be a danger of war between Prussia and Switzerland; but at length, in 1857, the King of Prussia renounced all his claims over Neuchâtel, which was thus put upon the same footing with the other cantons.

The annals of Switzerland for a number of years have little to record beyond the fact of constant moral and material progress. The principal event of this period is the revision of the federal constitution, a project for which was adopted after a protracted agitation on the 19th of April, 1874. While this agitation was going on several of the individual cantons set the example of revising their constitutions. In this proceeding Zürich led the way, appointing a special council for the purpose in January, 1868. It was followed by Bern, Aargau, Thurgau, Solothurn, and other cantons. All the modifications made were in a democratic direction. The chief opposition to the project of a revision of the federal constitution proceeded from the French cantons and the Ultramontane party, the former fearing that in consequence of a revision of the constitution in the direction aimed at, that of giving more power to the central authorities, they would be gradually Germanized, the latter believing that the influence of their party in those cantons where it was numerically strong would be curtailed. But in spite of this opposition the federal assembly, on Dec. 21, 1869, adopted the principle of a revision, and elected a committee to prepare a scheme for the purpose. The project of revision drawn up by this committee was laid before the federal assembly in the session of 1871-72, and after being accepted there was submitted to the people on the 12th of May, 1872, an article of the constitution then in force requiring that any proposed alteration of it must, before being adopted, be sanctioned by a majority of the people and of the cantons. On this occasion the project was rejected by a small majority; but a new one was drawn up and accepted on the date already mentioned, April 19, 1874. The new constitution gives more homogeneity to the confederacy by assigning to the federal authorities more power in matters relating to law, the army, the church, and education. The laws of the various cantons are partially assimilated; the management of the cantonal contingents to the army is no longer left entirely to the cantons themselves; the ecclesiastical authorities are completely subjected to the civil power; and primary education is made compulsory and secular. Since then two or three partial revisions have been carried out. A constitutional modification, for instance, was passed by the National Council in 1890 to the effect that in future when a revision of the federal constitution, or the admission into it of a new article, is proposed by popular initiative, this proposal must be supported by the votes of at least 50,000 citizens possessed of the right of voting, and not 30,000 as previously.

**SWORD**, a weapon used in hand-to-hand encounters, generally shaped somewhat like a large knife, and consisting of a steel blade and a hilt or handle for wielding it. The blade may be either straight

or curved, one-edged or two-edged, sharp at the end for thrusting, or blunt. The origin of the sword is lost in antiquity. The first metal used for making swords was probably copper, as men acquired the art of forging this metal sooner than any other. The ancient Greek swords were of bronze, and later of iron. The Romans in the time of Polybius (B.C. 150) had swords of finely-tempered steel. The Roman sword was short and straight. Wooden swords are found at present among many savage tribes. The straight, long sword was used by the Christians of the West in the middle ages, while the Poles and all the tribes of Slavonic origin employed, and still prefer, the crooked sword or scimitar. The Saracens also had the crooked sword at that time; and it is still the common one in Asia. In the middle ages double-handed swords also were worn. The double-handed sword was an unwieldy weapon, and probably originated from the wearing of plate armour. The sword is of much less importance in warfare than formerly, but European cavalry are still armed with it. All officers and sergeants in the British army wear swords. The kind of sword known as a cutlass is used in the navy. The Highland claymore, a broad sword with a basket hilt, was introduced into the Highland regiments in the British service. The blade of a sword is divided into the upper, middle, and lower part, or the *forte*, *middle*, and *foible*. The efficacy of no other weapon depends so much on the courage and skill of the individual. From the former importance of the sword it came to be connected with various matters of ceremonial. To this day the surrender of the sword denotes submission and the breaking of it degradation. In England the sword of state is one of the regalia and the 'offering of the sword' one of the ceremonies of coronation. In former times certain places acquired great celebrity for the fineness of their sword-blades, Damascus, Toledo, and Milan being especially famous on this account. Excellent sword-blades are made at Birmingham, the best cast-steel being required for their manufacture. See BROADSWORD, CUTLASS, RAPIER, and SCIMITAR; also CUTLERY and FENCING.

**SWORD-FISH** (*Xiphias*), a genus of Teleostean Fishes belonging to the family Xiphiidae, a group nearly allied to the Mackerels (which see), and represented by the Common Sword-fish (*Xiphias gladius*), and by the Sail-fish, Fan-fish, or Purple-finned Sword-fish (*Hiatiophorus immaculatus*), Pl. CIII. - CIV. fig. 3. In the Xiphiidae the body is elongated, and teeth are either absent or rudimentary. The upper jaw is much elongated, and prolonged to form a pointed sword-like structure. The ventral fins are generally wanting. The dorsal fin is spiny, and commences at the neck, where it is very high and somewhat crescentic in shape, being particularly high in the Sail-fish, which derives its name from the development of this structure. The caudal or tail fin is equally lobed, and its edges are ridged. The structure of their gills is peculiar, the gill-plates of each branchial arch being united so completely to form a band-like mass, that the separate laminae or gill-plates can be with difficulty recognized. The Common Sword-fish occurs in the Mediterranean Sea and Atlantic Ocean, but may also be occasionally found round the coasts of Britain. It may attain a length of from 12 to 15, or even 20 feet, and is a fish possessing great strength and courage. Its colour is a bluish-black above, and silvery white on the under parts. The ventral fins are wanting. These fishes are generally found in pairs, and in company with the Tunny. The Sword-fish is fished for by the Neapolitan and Sicilian fishermen, the mode of fishing being that by means of the harpoon. The flesh is very palatable and nutritious. There can be little doubt of the strength of these fishes, as exem-

plified by the frequent instances in which the timbers of ships have been found to be perforated through and through by the sword-like jaw, which has been left sticking in the wood. In almost every museum such specimens may be seen, and it has been asserted that such punctures have often sealed the fate of ships by causing a mysterious leak. These fishes also attack other fishes, and in the majority of cases inflict fatal wounds with their powerful weapons. The Sail-fishes (this name is applied to a species of Shark—see SHARK) occur in the Mediterranean, Atlantic, and Indian Seas. The dorsal fin is very high, and can be erected or lowered at will. The colour of this large fin is a very deep blue. Rudimentary ventral fins in the form of filaments exist in this genus, and the tail is deeply forked.

**SYBARIS**, an ancient Greek city of Lower Italy, in Lucania, on the Gulf of Tarentum, not far from the site of the later town of Thur I. It is supposed to have been built by a colony of Achæans and Troezenians about 720 B.C. It rapidly rose to an extraordinary degree of prosperity, but the people became enervated by the mildness of the climate, the richness of the soil, and their great wealth, and were in ancient times proverbial for their luxury and voluptuousness. Becoming involved in a war with Crotona the city of Sybaris is said to have brought into the field 300,000 men, while the forces of the former amounted to but 100,000. The Crotonians, however, were victorious, and totally destroyed Sybaris by turning the waters of the river Crathis against it (510 B.C.). The inhabitants of the town dispersed themselves for the most part over the other Greek cities of Lower Italy. Sybarite is still used to signify an effeminate voluptuary.

**SYCAMORE**. This term was given by the ancients to a species of fig (*Ficus sycamorus*). By the moderns it is applied to a European species of maple (*Acer pseudoplatanus*), and in the western parts of the United States to the Occidental Plane or Button-wood. See FIG, MAPLE, and PLANE.

**SYDENHAM**, a residential suburb of London, in the borough of Lewisham and county of Kent, in a beautiful and salubrious district studded with handsome seats and villas, on the London, Brighton, and South Coast Railway. It has become an object of national, or rather of European interest, from having been selected as the site of the Crystal Palace, opened by Queen Victoria on June 10th, 1854, and formed chiefly out of the materials of that which stood in Hyde Park in 1851. Pop. (1901), 43,630.

**SYDENHAM, THOMAS**, a celebrated English physician, was born in Dorsetshire in 1624, and in 1648 took the degree of Bachelor of Medicine at Oxford. He subsequently commenced practice as a physician at Westminster, and speedily attained great reputation. From 1660 to 1670 he held the first place in his profession, though it was not till the latter part of his career that he became a licentiate of the college. Being a great sufferer from the gout he was unable in the latter part of his life to go much from home; but he continued to benefit society by his writings and advice till near the time of his decease in 1689. Dr. Sydenham's improvements form an era in the history of medicine. He first applied himself to an attentive observation of the phenomena of diseases, founding his practice on the obvious indications of nature rather than on prevalent theories drawn from the principles of chemistry or mathematics. Febrile disorders attracted his especial notice, and in 1666 he communicated to the public the result of his observations in a work entitled *Methodus curandi Febres propriis Observationibus superstructa*, which was reprinted, with additions, under the title of *Observationes Medice circa Morborum acutorum Historiam*

et Ourationem (1675). Among his principal works are: *Epistolæ Responsoriæ* dñi, 1. *De Morbis epidemicis* a 1675 ad 1680; 2. *De Luis venereæ Historia et Ouratione* (1680); *De Podagra et Hydrope* (1683, 8vo); and *Processus integri in Morbis fere omnibus curandis*, published posthumously. The Sydenham Society, to which he gives its name, have published an English translation of his works, with a life of the author, by Dr. R. G. Latham (two vols. 8vo, 1848-50).

SYDNEY, the capital of New South Wales and the parent city of Australia, is picturesquely situated on the southern shores of Port Jackson, the shore line being frequently deeply indented by capacious open-mouthed bays, which form harbours in themselves. Some of these bays are the continuation of other harbours or openings which are navigable for several miles, so that the very heart of the city may be easily reached from the water. A number of the older streets are narrow and crooked, though much improvement has been effected here in recent years, but several of the more modern, such as the two main thoroughfares, George Street and Pitt Street, which intersect the city from north to south, York Street, Market Street, &c., present magnificent ranges of handsome edifices and elegant shops. Steam, cable, and electric tramways facilitate communication within the city and with the suburbs. The parliament has sanctioned a proposal to introduce electric traction on all the tramway routes. Communication with the northern or transmarine suburbs is kept up by numerous steam ferry-boats. Among the most important public buildings are the government offices (the colonial secretary's and public works offices, the crown-lands office, and the treasury), magnificent white freestone structures in the Italian style; the large and imposing town-hall, with a tower 156 feet high and a magnificent organ; the post and telegraph offices and government savings-bank, another grand block of chaste Italian architecture; the government house, a castellated building of the Elizabethan Gothic style, beautifully situated on the well-wooded promontory between Sydney Cove and Farm Cove; the University, also belonging to the Elizabethan Gothic style, with the associated colleges of St. Paul's (Anglican), St. John's (R. C.), St. Andrew's (Presbyterian), and Women's College; the free public library; school of art; the museum; grammar-school; St. Andrew's (Episcopal) Cathedral, a handsome Gothic building with two towers; St. Mary's (R. C.) Cathedral, now being rebuilt on a grander scale after destruction by fire; the Jewish synagogue, a fine edifice in the Byzantine style; exchange; custom-house; mint; parliament houses; the fine Queen Victoria markets; the new Sydney (1894) and other hospitals, asylums, and numerous other ecclesiastical, scholastic, and business buildings which would not suffer by comparison with the edifices of older countries. The city is well lighted with gas, and the electric light is used at the leading quay, the post-office, the railway terminus, and other places. The places of open-air recreation include the Domain, a beautiful park covering about 140 acres; Hyde Park, embracing 40 acres near the centre of the city; the Botanical Gardens, the finest in the colonies, about 38 acres in extent; Moore Park, 600 acres; the Centennial Park (1888), 768 acres; and the race-course, 202 acres.

The entrance from the Pacific Ocean to Port Jackson, about 4 miles north of Sydney, is 1 mile in width; the bay itself is about 10 miles in length and 8 in average breadth; it has a depth of water sufficient to float the largest vessels. The Circular Quay, at the head of Sydney Cove, has a length of 1300 feet, and can accommodate ships of any size; Woolloomooloo wharf, to the east, is 3000 feet in length, and

is used both by ocean steamers and coasters. The eastern shore of Darling Harbour, which skirts the western side of the city, has its entire frontage covered with wharfs and quays. The government has two graving-docks at Cockatoo Island, the more recent and larger being 680 feet long, and having a depth on the sill of nearly 80 feet. There are several other extensive dock works and building establishments belonging to private companies. The seaward fortifications include various forts connected by a military road, and there are now heavy guns mounted behind earthen parapets.

The principal exports are wool, tallow, hides, preserved meat, tin, copper, &c.; the imports, grain, tea, coffee, sugar, wine and spirits, ironware and machinery, cotton and woollen goods, wearing apparel, furniture, &c. The trade is extensive, and gives employment to the steamers of the Australasian United Steam Navigation Co., the Peninsular and Oriental Co., the Pacific Mail Co., the Orient line, the Messageries Maritimes, and others. There are foundries and engineering works, coach-works, woollen mills, &c. Sydney is connected by railway with the principal towns in Australia.

Sydney was founded in 1788, and was named in honour of Viscount Sydney, then secretary of state. It received its charter of incorporation in 1842. The discovery of gold in the colony in 1851 gave an immense impetus to its progress. The first international exhibition of Australia was opened here 17th Sept., 1879, and on 22nd Sept., 1882 the structure in which it was held was destroyed by fire. Pop. in 1891, with suburbs, 386,400; in 1901, 488,382.

SYDNEY, ALGERNON and SIR PHILIP. See SIDNEY.

SYENE. See EN-SOUAN.

SYENITE, one of the crystalline rocks, consisting of quartz, feldspar, and hornblende, and differing from granite chiefly in the substitution of hornblende for mica. Feldspar forms its most abundant ingredient: it is often coloured red. When the quartz and hornblende are fine-grained, and the feldspar is in distinctly-embedded crystals of considerable dimensions, the rock is called *porphyritic syenite* or *syenite porphyry*. Syenite, though unstratified, occasionally manifests a tendency to the columnar structure. It occurs in unconformable masses over granite, gneiss, mica-slate, and clay-slate. It abounds in Upper Egypt, at Syene or Assuan, whence it derives its name. The Romans brought it thence to Rome for architectural purposes and for statuary. The syenite of this region, however, is not regarded as true syenite by many modern petrographers, who give the name to a rock composed of feldspar (orthoclase) and hornblende, regarding the quartz as not essential to the composition of this rock.

SYLLA. See SULLA.

SYLLOGISM. See LOGIC.

SYLPHS, the name given to the elementary spirits of the air in the polytheistic-pantheistic system of the Paracelsists. The sylphs, like the other elemental spirits—the salamanders or spirits of fire, the gnomes or spirits of earth, and the undines or spirits of water—form the link between immaterial and material beings, for though, like men, they eat, drink, speak, travel, sicken, and beget children, they resemble the more elevated spirits in the liteness and transparency of their bodies and their rapidity of movement; they also know more of the present and the future than man does. They have no soul, and consequently suffer annihilation after death. They marry with our race, and the children begotten of such a union have a soul and belong to the human race. According to Pope (The Rape of the Lock) the sylphs 'assume what sexes and what forms they please', yet the poet has endowed them with such

ethereal graces that the term *sylyph* is now popularly applied to a maiden of a graceful form.

**SYLVESTER II.**, whose true name was *Gerbert*, was born of an obscure family in Auvergne, and at an early age entered the monastery of St. Gerard, in Aurillac. After laying a foundation for all the sciences cultivated in that age, he travelled into Spain to hear the Arabian doctors, and at length became so distinguished that he was appointed by Hugh Capet preceptor to his son Robert. Otho III., emperor, who had also been his pupil, conferred upon him the Archbishopric of Ravenna in 998; and on the death of Gregory V., in 999, procured his election to the papacy, when he took the name of Sylvester. He acted with great vigour in this capacity, and maintained the power of the church with a high hand. He was also a great promoter of learning, and a proficient in various branches of science himself. His scientific knowledge, as was frequently the case in the middle ages, procured for him the reputation of a magician. He expended large sums in the collection of books; composed a number of works, particularly on arithmetic and geometry; and with his own hands made a clock, a globe, and an astrolabe. A number of his letters on various subjects were printed at Paris in 1611; but the most complete collection has been given by Du Chesne. He died in 1003.

**SYLVIVS, ÆNEAS.** See **PIUS II.**

**SYMBOL** (in Greek *symbolon* or *symbolon*; Latin, *symbolum*, from *sumballein*, to suspect, divine, and compare), a word of various meaning even with the ancients, who used it to denote a sign, a mark, watchword, signal, token, seal-ring, &c. Its meaning is still more various in modern times. *Symbol* is generally used as synonymous with *emblem*. It is not confined, however, to visible figures, but embraces every representation of an idea by an image, whether the latter is presented immediately to the senses, or merely brought before the mind by words. The name of *symbols* is also given in the Christian church to those doctrines expressed in short formulae, which are acknowledged by all Christians; therefore to the confessions, so called, which contain the essential points of the belief of the various sects. Symbols, in this sense, are not put upon an equal footing with the Bible; but because, according to the opinions of the sect, they contain the sense of the Bible, every one must profess his belief in them who wishes to be acknowledged as a member of the particular denomination. See **CREED**.

**SYMBOLS, ASTRONOMICAL**, signs or symbols which conveniently represent astronomical objects, phases of the moon, &c., and astronomical terms. Some of these symbols are so ancient that we can find no satisfactory account of their origin. They are as follows:—

#### *Symbols of the Heavenly Bodies.*

Sun .....	☉	Juno .....	♄
Mercury .....	☿	Vesta .....	♍
Venus .....	♀	Jupiter .....	♃
Earth .....	♁ and ♁	Saturn .....	♄
Moon .....	☾	Uranus .....	♅
Mars .....	♂	Neptune .....	♆ or ♁
Ceres .....	♀	Comet .....	☄
Pallas .....	♁	Star .....	★

The asteroids, except the four given above, are represented by a circle with a number, thus, (64), designates *Angelina*, the sixty-fourth asteroid, in order of discovery.

#### *Lunar Phases.*

- Moon in conjunction, or *new*.
- ☾ Moon in eastern quadrature, or *first quarter*.
- Moon in opposition, or *full*.
- ☾ Moon in western quadrature or *last quarter*.

#### *Signs of the Zodiac.*

Aries .....	♈	Libra .....	♎
Taurus .....	♉	Scorpio .....	♏
Gemini .....	♊	Sagittarius .....	♐
Cancer .....	♋	Capricornus .....	♑
Leo .....	♌	Aquarius .....	♒
Virgo .....	♍	Pisces .....	♓

#### *Planetary positions.*

Ascending node .....	♊	Eastern Quadrature..	E ☐
Descending node .....	♋	Western Quadrature..	W ☐
Conjunction .....	♌	Trine .....	△
Sextile .....	♍	Opposition .....	♌
Quadrature .....	☐		

#### *Astronomical contractions.*

- Right ascension, R.A., *AR*, or *α*.
- Declination, Dec. or *δ*.
- North polar distance, N.P.D.

**SYMBOLS, CHEMICAL.** In writing down chemical reactions much assistance is derived from the use of a species of shorthand or symbolical language, inasmuch as we are thereby enabled to put a great deal of information into a very small space, and also because this language is universal among chemists, being instantly understood by chemists of every country and language. The symbols of the chemical elements are merely the first letters of the names of these elements (not in every case of their *English* name); or, when the names of two or more elements begin with the same letter, two letters are used as the symbol, one of which is always the first letter of the name of the element. Generally speaking the letters comprising the symbol are taken from the English name of the element; but in some instances, specially in the cases of metals which have been long known, the symbols are derived from the Latin names: thus we have *Hg*, the symbol for mercury, from the Latin *Hydrargyrum*; *Fe*, from the Latin *Ferrum*, for iron; and so on. In a few cases the symbols are deduced from the old German names: thus *K*, the symbol for potassium, is the first letter of the old German word *Kalium*, and *Na*, the symbol for sodium, is from the German *Natrium*. However derived, whether from English, German, Latin, or French, the symbols of the chemical elements are universally the same. For a considerable time French chemists employed the symbol *Az* to represent nitrogen, from the name *Azote*, which was given to this element in reference to the fact that it alone could not support life (Greek, *a*, privative, and *zōē*, life); but this symbol is now almost entirely superseded by the letter *N*. The symbols of chemical compounds are constructed by placing together the symbols of their constituent elements, a number being attached to each signifying how many atoms of the element enter into the composition of the amount of the compound expressed by the entire symbol. For it must be understood that chemical symbols have a quantitative as well as a qualitative meaning. When a chemist meets in a chemical treatise with the symbol *O* he knows that this signifies not only oxygen but a certain definite amount by weight of oxygen. *O* always means 16 parts by weight of

oxygen, so *Fe* means 56 parts by weight of iron; and so also the compound symbol  $Fe_2O_3$  means  $(56 \times 2) + (16 \times 3) = 160$  parts by weight of oxide of iron. For a further account of the uses and modes of formation of chemical symbols see the article CHEMISTRY.

SYME, JAMES, one of the most eminent surgeons of the nineteenth century, was born at Edinburgh, 7th November, 1799. He was educated at the High School of that city, and at the university, which he entered in 1815; he became a student of anatomy under Barclay in 1817, and when his relative Robert Liston commenced a course of lectures on his own account in 1819 Syme went with him as his demonstrator. When only in his twenty-third year he undertook to lecture occasionally for Liston on systematic anatomy, and had entire charge of the dissecting rooms. About this time he went to Paris, and studied for a short time under Dupuytren and Lisfranc, and in the summer of 1824 he visited the surgical schools of Germany. In 1829, when an appointment to a vacancy in the staff of surgeons connected with the Edinburgh Royal Infirmary was refused him on the ground that Liston, with whom he had quarrelled, was already there, and that the co-operation of the rivals would be far from cordial, he started an hospital of his own, at Minto House, near the university, well knowing that it was impossible to become a great surgeon without the extensive practice furnished by such institutions. For more than four years he laboured in this sphere, examining patients, lecturing to students, writing reports of special cases, issuing reports of the surgical hospital from time to time, preparing the first edition of his great treatise *The Principles of Surgery*, and with all this work resting on him doing the duties of an extensive private practice. In 1833 he was appointed to the chair of clinical surgery in the university, and at the same time the managers of the infirmary placed three wards under his control; and when, in the following year, his rival Liston was transferred to London, Syme was regarded as *facile princeps* in his profession in Scotland. An immense and lucrative practice, with abundant honours, quickly followed. In 1848, on the death of Liston, to whom he had been at last reconciled, he was invited to fill the post thus rendered vacant in the University of London. He accepted the offer, but resigned the post, after but three months' residence in London. He returned to Edinburgh, and was at once reinstated in the chair and the surgery which had remained vacant since his departure. He died of paralysis, 26th June, 1870. Besides his *Principles of Surgery*, already referred to, and which has gone through many editions, he published a paper on *Incised Wounds* (1825), an *Essay on the Nature of Inflammation* (1828), a *Treatise on the Excision of Diseased Joints* (1831), *Contributions to the Pathology and Practice of Surgery* (1848), and other productions written in a clear, terse style, all characteristic of the unrivalled teacher and the unsurpassed operator.

SYMMETRY OF ANIMALS, the name used by the philosophical zoologist to express the idea of the specific modes of the *elements of form* of the animal frame. Animal symmetry is of three kinds: *zonal symmetry* (as in *Annulosa*), where the merosomes or elements of form are arranged in a zonal manner, one after the other, in a longitudinal axis; *secondly, bilateral symmetry* (as in *Vertebrates*, *Annulosa*, &c.), in which the body can be divided into symmetrical halves by a line passing down through the median vertical plane; and *thirdly, radial symmetry* (as in *Cœlenterata* and *Echinozoa*), in which the parts of the body are disposed in a

radial manner around a central point, which is generally the mouth. Symmetry thus expresses the morphology of the *outer form* of animals; but it cannot be shown to have any relations to deeper parts or structures, as maintained by most evolutionists.

SYMPATHETIC INKS. With certain liquid characters may be traced which remain invisible until acted upon by heat or by some other reagent. Among the best-known sympathetic inks are—*solution of galls*: the characters traced by this liquid remain invisible until washed over with a dilute solution of protosulphate of iron, when they appear dark brown or black; *cobalt*, dissolved in aqua regia, and diluted with water, yields a fluid which becomes green when warmed, the colour disappearing as the liquid cools; dilute *yellow prussiate of potash* may be used for writing with, the characters only becoming visible when wetted with protosulphate of iron solution; solutions of *gold* or *silver salts* yield inks, the characters traced with which only become visible when exposed to the rays of the sun. In each instance a chemical change is brought about resulting in the production of a distinctly coloured substance.

SYMPATHETIC NERVOUS SYSTEM, the name applied to a set of nerves in Vertebrate animals, forming a nervous system distinct from, and yet connected with, the chief nerve-centres, or *cerebro-spinal nervous system*. (See NERVE and SPINAL CORD.) The sympathetic system consists of a series of *ganglia* or nervous masses, connected together by nerve cords, the ganglia being disposed along the spine from the base of the skull to their termination in the coccyx. These nerves are not inclosed, like the cerebro-spinal centres, within any special case or cavity such as the skull and spine, but are contained within the general body cavity. The name *sympathetic nerve* was given to this system from the belief of the older physiologists that it formed the means whereby the sympathies between different organs and parts were exhibited. It sometimes receives the name of *nervous system of organic life*, from the belief, which is not wholly correct, that the nerves of this system alone influenced the organic functions—such as digestion, circulation, &c. The fibres of the sympathetic nerves evince a different (microscopic) structure from that of ordinary nerves, as explained in the article NERVE (which see). The parts of which this nervous system is composed are sometimes divided by anatomists, firstly, into those ganglia situated on the main trunks and branches of the nerves (cerebral) originating from the brain and on those emanating from the spine or spinal nerves; and secondly into those parts which lie along the course of the spine. Whatever the situation of these nerve-masses, their structure is similar, and exhibits firstly free nerve-corpuscles; secondly, ganglion-corpuscles, giving origin to (thirdly) nerve-fibres; and fourthly, distinct nerve-fibres which do not originate in the ganglia, but simply pass through them. The nerves arising from sympathetic ganglia are composed of fibres derived from their respective ganglia, and from ganglia belonging to both cerebral and spinal nerves. Fibres from the brain and spinal cord also enter into the sympathetic trunks—the spinal cord contributing very largely to the composition of the sympathetic nerves. The chief *plexuses* or centres of the sympathetic system form nerve-masses of considerable size—the cardiac plexus in the neighbourhood of the heart, and the solar plexus, which supplies all the organs of the abdomen with sympathetic fibres, being the most important of the masses. Regarding the *functions* of this intricate system of nerves, these may firstly be included in the statement that the sympathetic nerves act like the fibres

of the cerebro-spinal or ordinary nerves, in transmitting impressions, whilst the sympathetic ganglia serve as nerve-centres in originating, transferring, and conducting these impressions, as when pain is experienced in a region, and from an organ, which is ordinarily without the region of common sensation. The sympathetic nerves have little or no power in exciting muscular action, such as is possessed by the ordinary motor nerves of the body.

The chief duties of the sympathetic nerves appear to consist in the regulation of processes of *involuntary motion*, of *secretion*, and of *nutrition*. Thus the motions of the heart, stomach, and intestines are chiefly, and certainly under ordinary circumstances, of involuntary character, and are controlled by sympathetic nerves. In cases of strong mental agitation, for example, these movements may be accelerated, but in an indirect and unusual manner. That the parts thus supplied with motor power by sympathetic fibres are independent, so far as their motion is concerned, of the brain and spinal nerves, and indeed of other sympathetic fibres, is shown by the removal of the heart of animals (such as Frogs, &c.) from the body, when it may continue to beat for hours, notwithstanding the violent experimental treatment. The influence of the sympathetic system in the circulation of the blood is very well seen in the case of the muscular coats of the arteries, which are supplied with sympathetic fibres which are named *vaso-motor nerves*. These nerves, therefore, control the muscular movements of the blood-vessels in the propulsion of blood; and if irritated or divided the muscular fibres become paralyzed and the blood-vessels remain in a dilated state. It is highly probable that the sympathetic nerves influence the *nutrition* of the parts they supply, but cerebro-spinal nerves have also certainly much to do with the maintenance of the nutritive energies in organs and tissues. In *secretion* (which see) the influence of this system of nerves is also exhibited in virtue of its controlling action over the blood-vessels which supply blood to the secreting structures.

**SYMPATHY**, a term at one time employed to explain the fact that one part or organ of the body suffered with another part, with which there was no obvious relationship, or no connection that seemed sufficient to explain the occurrence. The term is yet so employed, and sympathetic cough, sympathetic headache, or sympathetic vomiting are by no means uncommon phrases. But the progress of physiology and of pathology has revealed and made quite clear relationships of a direct kind between distant organs, not formerly understood, so that in many cases the connection between disease of one organ and disorder of another is no longer obscure. So that though the term is retained, or rather the usage of language renders it difficult to give it up, it is no longer employed with the same vagueness of meaning as before. The production of sneezing by the falling of a strong light upon the eye was at one time spoken of as a phenomenon of sympathy. It is now explained by reflex action. In uterine diseases the occurrence of vomiting or of headache is a frequent symptom, and was also spoken of as sympathetic. It is now known to be due to nervous communication. And numerous other illustrations might be given. The chief media of communication between the various organs and tissues of the body are the blood-vessels, the lymph-vessels, and the nervous system. Thus, if an abscess in the armpit attend some wound of the hand, it is not spoken of as due to sympathy, for it is known to be the result of unhealthy material from the sore being conveyed along the lymph channels of the limb to one of the lymphatic glands of the armpit. The unhealthy material then excites inflammation

and suppuration of the gland. *Sympathy* is further used to express the influence which the state of one individual exercises upon another, as is seen, for example, in the case of hysterical convulsions, which affect a number of females upon seeing one of their companions suffering from hysteria; or the yawning produced by seeing another yawn; or the sorrow produced by witnessing his grief.

**SYMPHONY**, an elaborate musical composition for a full orchestra, consisting usually, like the sonata, of three or four contrasted, yet inwardly related movements, as an andante followed by an allegro, another andante varied or an adagio, a minuet with its trio or a scherzo, the whole composition closing with a lively rondo or rapid finale. The symphony, which may be regarded as the highest kind of musical composition, was unknown in its present form before the time of Haydn, who with Mozart, Mendelssohn, and Beethoven are the most successful composers of this class of compositions. The nine symphonies of the latter are generally recognized as being the noblest works of their kind. The term symphony is also frequently applied to short introductory or closing instrumental passages in compositions which are predominantly vocal, or in other words to the ritornello (which see).

**SYMPTOMS**, in medicine, the phenomena of diseases, from which we infer the existence and the nature of the disease. Symptoms have their seat in the functions which are affected by the disease so as to be raised above their usual activity, or depressed below it, or even to become changed in the nature of their action. The organs themselves are often changed in their appearance, structure, size, &c. Symptoms may be perceptible by the patient alone (for example, pain and all change of sensations), or by the physician also (for example, all diseased movements). The more a function or an organic system is extended through the body, the more frequently will it be the seat of morbid phenomena. The nervous, the vascular, and the cutaneous systems, for instance, are affected in most diseases; hence also irritability, the power of nutrition, &c., which extend through the whole organization, are so easily affected by diseases, and thus afford symptoms. If the latter are in the organs originally affected they are called *idiopathic*; but if they are caused by sympathy with other and distant parts, they are called *consensual* or *sympathetic*. The temperament, age, sex, mode of living, &c., of the patient produce a considerable variety in the symptoms of every disease.

**SYNAGOGUE** (from the Greek *synagoge*, an assembly), the recognized place of public worship among the Jews. We know too little of the social and religious life of Israel, both before and after the monarchy, to be able to decide with certainty whether there was anything corresponding to the synagogue of a later date. Its origin, it is supposed, belongs most probably to the date of the Babylonian captivity in the abeyance of temple worship, and it appears to have reached its full development on the return of the exiles to their native land. The site of the synagogue was chosen on the highest ground in or near the city or village to which it belonged; the building was so constructed that as the worshippers entered and as they prayed they looked toward Jerusalem. It was erected out of the common funds or the gifts of the community, and was supported by taxes and donations. At the extreme east end was the holy ark (*aron hakkodesh*), containing copies of the Pentateuch; in front of this was the raised platform for the reader or preacher. The men sat on one side of the synagogue and the women on the other, a partition 5 or 6 feet high dividing them. The chief seats, after which the scribes and Pharisees

strove, were situated near the east end. On the completion of a new synagogue it was consecrated by a special prayer, and after this ceremony none of the common acts of life, as eating, drinking, casting up accounts, &c., might be performed in it. Alms-boxes were placed at or near the door, one for the poor of Jerusalem, the other for local charities. The constitution of the synagogue was congregational, not priestly. The priests were indeed always honoured when present, more especially as they would be called on in that case to pronounce the closing benediction, but they had no special synagogal standing or privileges. Unlike the priests, too, the office-bearers were not hereditary, but were chosen by the congregation. Where a full organization, as in a town or populous district, was possible, there was a college of elders, presided over by one who was the ruler of the synagogue. This body managed the affairs of the synagogue, and possessed the power of excommunication. The officiating minister, the *sheliach tsibbur* or *legatus*, was the chief reader of the prayers, the law, the prophets, &c. The *chazan*, or servant of the synagogue, had the general charge of the building, had to open the door, had to present the scroll to the reader, and assist on various occasions. On week-days he generally acted as schoolmaster to the young of the congregation. There were, besides, other ten men attached to every synagogue—men of leisure (*batlanim*), whose business duties allowed them to attend the week-day as well as Sabbath services, who were always at hand to make up the minimum number (ten) of worshippers. Although possessing regularly-appointed teachers, the right of instruction in the public assembly was not strictly confined to those. The ruler of the synagogue might call upon any one present to address the people, or even a stranger might volunteer to speak. The modern synagogue differs little from the ancient. There is instead of elders a body who simply act as a committee of management; and the women are now provided with seats in a low latticed gallery.

**SYNALLAXIS**, a genus of Insectorial birds, characterized by having a slender pointed beak, the upper mandible slightly arched, the lower straight; nostrils oblong, covered with a membrane and with small feathers at their origin; tarsi naked, annulated; hallux elongated; wings short and rounded; tail long and pointed, composed of broad feathers. The birds of this genus inhabit South America from Brazil and Chili to the Straits of Magellan and Terra-del-Fuego. These birds are allied to the Tree-creepers (*Certhia*), Wall-creepers (*Tichodroma*), Nut-hatch (*Sitta*), &c., but their habits are not well known. They are believed to live on gnats and other insects. The Red-headed Synallaxis (*Synallaxis ruficapilla*), a native of Brazil, is shown at ORNITHOLOGY, Pl. II., fig. 4.

**SYNAPTA**, a peculiar genus of Sea-cucumbers or Holothuridae—animals allied to the Sea-urchins and Star-fishes, and belonging to the Echinodermata (which see). The family Synaptidae is distinguished by the non-development of the system (*ambulacral system*) of tube feet, which are so well seen in the more typical Holothurians. Locomotion in Synapta is accordingly effected by the muscular contractions of the body, aided by the presence in the skin of anchor-shaped spicules of lime, which these animals use to fix one portion of the body, whilst the other portion is approximated to the fixed part by muscular action. The mouth is surrounded by tentacles. These animals live in muddy coasts, and appear to form for themselves a kind of muddy investment or case.

**SYNCOPE**, the name given to that form of death characterized by failure and cessation of the heart's

action as its primary feature. The term is also applied to the state of fainting, presumably produced by the same cause. Fatal syncope appears to result either from defective innervation of the heart's tissues or from a spasmodic action impeding the natural relaxation of its tissues after contraction. Syncope is thus usually the result of some nervous 'shock,' resulting from some severe lesion of organs in tissues, or from a want of blood or an altered and abnormal state of blood pressure. The influence of pressure in producing syncope is well seen in cases of death caused by allowing patients who have been long ailing, and who have been lying in the recumbent position, to suddenly assume the erect posture. The sudden alteration of posture altering the blood pressure, or the pressure of other fluids—as in cases of dropsy—induces syncope, often of fatal nature. The treatment of cases of ordinary syncope depends chiefly upon the removal of the exciting cause—weakness, mental emotion, &c.—of the ailment. When attacked the fainting patient should be laid on a couch, and the head kept low; whilst great caution must be observed in stimulating the action of the heart.

**SYNDIC**, in government and commerce, an officer in various countries intrusted with the affairs of a city or other community, company of art or trade, &c., who calls meetings, makes representations and solicitations to the magistracy, &c.

*Syndic* is also a person appointed to act in some particular affair in which he has a common interest with his constituents, as when he is one among several creditors of the same debtor.

**SYNECDOCHE**, in rhetoric, a figure in which the whole of a thing is put for a part of it only, or a part for a whole, as the species for the genus, the genus for the species, &c.

**SYNGNATHUS**. See PIPE-FISHER.

**SYNOD**, an ecclesiastical assembly convened to consult on church affairs. A synod may be composed of a bishop and the clergy of his diocese (*synodus diocesana*, diocesan synod), or of an archbishop and the bishops of his province (*synodus provincialis*), or of the whole clergy of a state under a Papal legate (*synodus universalis* or *nationalis*). Synods in the Presbyterian Church are courts of review immediately above the presbyteries, and consist of all the ministers and elders who stand on the roll as constituent members of so many contiguous presbyteries, which are placed under the provincial jurisdiction of a synod. Every judgment of a synod may be brought under the review of the General Assembly. (See ASSEMBLY (GENERAL), and PRESBYTERIANS.) The convocations of the English clergy are provincial synods. See CONVOCATION.

**SYNODICAL PERIOD**, the period between two successive conjunctions or oppositions. A synodical month is a lunation, being the period from full moon to next full moon, or from new moon to next new moon. A synodical month is 29 days, 12 hours, 44 minutes 2·37 seconds.

**SYNONYMS**, or words having the same signification, strictly speaking, do not exist in any language. Different dialects of the same language may indeed have different words of the same meaning, but as soon as these pass from the dialect into the literary or generally adopted language, they either take the place of some other word of the same signification, or receive themselves a new shade of meaning, and are then added to the others. It is true that the similarity in the meaning of words is often so great that much discrimination is required to ascertain the different shades of meaning, and an abundance of such synonyms proves great acuteness in a nation. The more a nation ad-

vances in civilization the more it classifies ideas, unites the various species under the genus, and the more synonyms are required, as they are words which, with a general resemblance, have characteristic differences, as *cruelty* and *atrocious*, *riches* and *treasures*. Synonyms form an important subject of philological study, and the want of works in this branch of study was early felt. Towards the end of the second century Jul. Pollux wrote his *Onomasticon*, a work of some merit on Greek synonyms; and another work on the same subject was written by Ammonius. Vaugelas, Guizot, Bourguignon, Sardou, and Lafaye have written on French synonyms; Blair, Booth, Crabb, Taylor, Smith, and Soule on English; Eberhard, Weigand, and Sanders on German; Döderlein, Schultz, Shumway, Tegge, and others on Latin; and Schmidt on Greek. Many of the more copious dictionaries of the different languages devote a good deal of attention to the discrimination of synonyms.

**SYNOVIAL MEMBRANE**, the membrane lining the various *joints* or articulations, and which secretes a peculiar fluid—the *synovial fluid*—for the due lubrication of the joint. In the joints this membrane generally exhibits a tubular arrangement, its open extremities being attached to the edges of the articulating parts of the bones, which enter into the composition of the joint. It also covers the various ligaments uniting these bones. The structure of the synovial membrane resembles that of the serous membranes, described in full in the article **MEMBRANE** (which see). But its secretion or *synovia* is a thick viscid fluid somewhat resembling *white of egg* in general appearance. It is yellowish-white in colour, has an alkaline reaction, and a saline taste. Chemical analysis shows it to be composed in the ox of

Water.....	94.85
Mucous and epithelium.....	0.56
Fat.....	0.07
Albumen and extractive matter..	3.51
Salts.....	0.99 (Frichs' analysis.)

Synovial membranes exhibit a threefold division into *articular*, *bursal*, and *vaginal* kinds. The articular kinds exist in the movable joints, exhibit foldings, and contain fat. *Bursæ* are important structures which exist between surfaces which move freely upon each other. Thus *bursæ* are found between the skin and patella or knee-cap, and between the *glutei* or hip-muscles and the great *trochanter* of the thigh-bone. They thus limit the friction which would otherwise exist. *Bursæ* are liable to inflammation, this lesion in the bursa of the knee producing the disease known familiarly as 'Housemaid's Knee.' The *vaginal* synovial membranes, or *synovial sheaths*, form sheaths for the passage of the tendons of muscles, as seen in those surrounding the tendons of the flexor and extensor muscles of the fingers and toes.

**SYNTAX** (Greek, *syntaxis*, construction), that part of grammar which treats of the manner of connecting words into regular sentences. A word expresses a single notion, but by itself is little more than an articulate sound, which, like the cry of animals, intimates a wish or a feeling. A succession of such sounds, properly arranged and connected, becomes language. The art of constructing sentences is therefore not less important than the power of speech; it is indeed the intellectual part of language and a characteristic of reason. One class of words—the particles, or the accessory parts of speech, as they are sometimes called—serve merely to indicate the relations in which the principal or necessary parts (noun and verb) stand towards each other, or rather, like the sinews of the human body, to bind together what would otherwise be a heap of discon-

nected and useless limbs. In every language there is some fundamental principle which pervades and regulates its whole construction, although it may occasionally admit of particular variations. Passion or the excited imagination, for instance, will often violate, as the grammarians call it, the general laws of construction. In some languages the principle of juxtaposition prevails, and little diversity of arrangement is possible. The relations of the subject, the action, and the object are indicated by their respective positions. In other languages these relations are indicated by the changes in the forms of the words, and the modes of arrangement are various. Still in the structure and disposition of sentences and parts of sentences the logical relations of the thoughts must regulate the construction, even where it appears to be most arbitrary.

**SYNTHESIS** (literally 'connection,' 'union') is a term used generally as contradistinguished to *analysis*. Combining and separating are the chief operations by which we acquire knowledge; the former, however, is first in time. When an object is presented to our vision we form the idea of a whole out of its parts; but the intellect in forming general notions separates the given subject (*analysis*), and then unites (*synthesis*) what is common to several things, excluding what is peculiar to each. A synthetic or progressive proof or demonstration is one which proceeds from the reasons to the consequences, or from the general to the special; an analytical or regressive one ascends from the consequences to the reasons. This also explains the meaning of the expression *synthetic* and *analytic* method; the former is that process in science which begins with the principles, and from them deduces a particular conclusion, as is strictly done in mathematics; yet mathematicians themselves give the name of *synthesis* to that part of their science which contains the proofs of the theorems already laid down; *analysis* they call that part which seeks to form theorems.

**SYNUSIANS**. See **APOLLINARIANS**.

**SYPHILIS**, a word of unknown origin, is the name now most frequently used for a disease usually communicated by impure sexual connexion. It is thus called in a poem (Syphilides), written in Latin hexameters, by the Italian Fracastoro (first printed in Venice, 1530, 4to). The history of this disease is one of the most difficult parts of the history of medicine. It now seems quite certain, however, that the violent and truly malignant epidemic which appeared in the last ten years of the fifteenth century was really what we now call syphilis, though at the time it was thought to be a variety of the leprosy. Towards the end of the fifteenth and at the beginning of the sixteenth century a disease, till then unknown, appeared in Europe, and which, by its rapid extension, its horrible consequences, its great contagiousness, the inefficacy of all the remedies employed against it, perplexed the physicians, and excited a general horror. Respecting its origin nothing certain is known. The physicians of that time were, generally speaking, too ignorant to investigate the origin of a disease which they were but rarely able to cure. It was once pretty generally believed that this malady was carried by the vessels of Columbus from America to Europe; but a careful inquiry shows only that the crew of Columbus brought a contagious disease with them, which destroyed the greater part of their number, and communicated itself to those who had intercourse with them. This is easily explained by the imperfect care taken of the health of such a crew, and the uncommon hardships of such a voyage in those times. At all events their complaint was not the venereal disease, as this broke out almost at the same moment, in the summer of 1493, in the south of France, in

Lombardy, and in the north of Germany. Now the vessels of Columbus did not arrive till April at Seville, and the disease could not possibly have spread so far from this place within two months. The dreaded disease showed itself in Spain in 1493, appeared in Italy a year later, reached Switzerland in 1496, England also in the same year, and Scotland in 1497. The ancient writers for many years described syphilis more as a terrible disease of the skin and bones in general than as a mere affection of particular parts; more as a plague than as a disorder of particular individuals. A new form of disease could be developed the more readily, as the political relations of that time brought the nations very much into connection with each other: Spaniards, French, Germans, traversed Italy, and all these, together with the Italians, spread through Germany. The disease brought by the sailors from America, akin to scurvy, may also have contributed its part. It is certain that the disease was then far more terrible than now. It made the patient an object of horror to his friends, and almost inevitably reduced him to despair, as no physician was able to aid him, and the remedies used were almost as shocking as the disease. Since contagion at that period took place much easier than now, and houses of ill-fame, which contributed greatly to spread the disease, were found everywhere, the disorder had by no means the same character of disgrace connected with it as at present. On the contrary, Ulrich von Hutten, who suffered from it for years, and at length recovered his health by the use of guaiacum and the strength of his constitution, always enjoyed public esteem, and even dedicated his work on the disease to the first spiritual prince of Germany without indecorum or offence. Like other diseases, it gradually diminished in virulence, particularly after Paracelsus had found in mercury, and Swediaur in acids, the most effective remedies against it.

SYPHON. See SIPHON.

SYRA (the ancient *Syros*), an island in the *Ægean* Sea belonging to Greece, and included in the Northern Cyclades, 18 miles south of Andro; length, north to south, 10 miles; breadth, about 6 miles. The coast is bold and rugged, with numerous indentations, one of which, on the east, where the capital of same name stands, furnishes an excellent harbour; the interior is intersected by hills and narrow valleys, and though in some parts almost sterile, partly from a deficiency of water, is generally covered with a moderately fertile soil, producing wheat, barley, cotton, wine, and figs, but not in sufficient quantity for home consumption, the common necessities of life having to be imported. During the war of Independence Syra remained neutral, and as her port continued open it became the centre of Greek commerce. The climate, cooler and more humid than that of the surrounding islands, has the reputation of being very salubrious. Pop. 33,370.—SYRA, or HERMUPOLIS, the capital, near the site of the ancient Syros, consists of a number of tolerably spacious streets, rising terrace-wise above each other from the bay, and lined with well-built houses. It is the seat of government for the Cyclades, the see of a bishop, and the residence of foreign consuls. It has a considerable trade, maintaining regular communication with all the principal towns in the Levant. Pop. (1889), 22,104.

SYRACUSE (now *Siracusa*), anciently the chief city of Sicily, and one of the most magnificent cities in the world, with 500,000 inhabitants, is now greatly reduced, but still has an excellent harbour, capable of receiving vessels of the greatest burden, and of containing a numerous fleet. The ancient city was of a triangular form, 22 miles in circuit, and con-

sisted of five parts surrounded by a massive wall, namely, Ortygia, frequently called simply the Island, on an island between the two harbours; Achradina, extending along the sea-side; Tyche, so called from its containing a temple of Fortune, Epipolæ, and Neapolis (New-city), forming the western part. At present the only part of ancient Syracuse inhabited is the south-east corner, the island Ortygia. The modern town is fortified, and is lighted by electricity. The streets are regular, but narrow, and the houses tolerably built. There are few buildings of interest in the town. The cathedral is formed out of an ancient temple. The papyrus plant is still found in the neighbourhood. Syracuse was founded by a colony of Corinthians under Archias, B.C. 734. It became the largest and most wealthy city in Sicily, and, according to Thucydides, possessed a greater population than Athens or any other Grecian city. It was at one time governed as a republic, the political power being in the hands of the landed proprietors, named Geomori or Gamori; at another by Gelon, Hiero, Dionysius (see these articles and TIMOLEON), and other rulers. For the unfortunate Athenian expedition against it see GREECE. In B.C. 215 it was invested by the Romans, under Marcellus and Appius. It was defended nearly three years by the genius and enterprise of Archimedes, but at last fell into the hands of the Romans (B.C. 212), and continued in their possession till the downfall of their empire. Here are remains of the ancient amphitheatre, of an oval form, 300 feet in length and 200 in breadth; the arena, seats, and passages of communication were cut out of the rock. The catacombs form a remarkable feature of Syracuse. They are only 7 or 8 feet high; but their extent is such that they form a kind of subterranean city, with a number of narrow streets, some of which are said to be a mile long, and contain tombs and sepulchral chambers. The speaking grotto, or, as it was called by the ancients, the *Ear of Dionysius*, is a cave 170 feet long, 60 high, and from 20 to 35 wide, with so strong an echo that the slightest noise is overheard in the small chamber near the entrance, in which Dionysius is said to have listened to the conversation of his prisoners. The fountain of Arethusa is still a striking object, but its waters are now salt, a result caused by an earthquake. Theocritus and Archimedes were natives of Syracuse. Pop. (1901), 32,074.

SYRACUSE, a city of the United States, capital of Onondaga county, state of New York, on the Onondaga Lake, Erie Canal, and several railway lines, about 148 miles west of Albany. It has spacious and well-built streets, handsome churches, splendid hotels, a town-hall, a post-office, a savings-bank, a state hospital, a court-house, a museum of fine arts, a city library, and the fine buildings of Syracuse University. Besides an extensive traffic by railway and canal, it has large salt-works, supplied with brine from pits in the vicinity; and among other industrial establishments are rolling-mills, steel-works, forges, alkali-works, &c. Pop. (1890), 88,143; (1900), 108,374.

SYRIA (Turkish, *Soristan*; Arabic, *Es-sham*), a country forming part of Asiatic Turkey, between lat. 31° and 37° N., and lon. 33° 30' and 39° E.; and bounded on the north by the Taurus range, separating it from Asia Minor; on the north-east by the Euphrates; on the east by the Syrian desert; on the south-east and south by Arabia; on the south-west by Egypt; and on the west by the Mediterranean. Greatest length, north to south, about 420 miles; greatest breadth, about 190 miles; area, estimated at about 146,000 square miles. The coast has some low sandy tracts, but is in general, though not deeply indented, lofty and precipitous, rising, particularly

in Mount Carmel, to the height of 3000 feet. It has few good harbours, and is often lined with shelves, which make its navigation dangerous. The most remarkable feature of the interior is a mountain-chain, which, continued from the Sinai Peninsula in the south, stretches over the whole length of the country, till it becomes linked with the Taurus in the north. The southern part of this chain, where it enters Palestine, consists of two parallel ranges. The western range, lowering as it proceeds north, assumes the form of a plateau, which has an average height of about 2500 feet in the vicinity of Jerusalem, but afterwards sinking rapidly, has at the northern extremity of the plain of Esdraelon, near the foot of Mount Tabor, a height of rather less than 480 feet. At this point, however, it assumes a new elevation, and taking the name of Lebanon or Libanus, attains in its culminating point the height of 10,625 feet. The eastern range forms a continuation of the great chain of Western Arabia, pursues the same direction as the western range, and though it also rests on a plateau which towards Damascus has a height of above 2000 feet, is in general of moderate elevation. On approaching Libanus it takes the name of Anti-Libanus or Antilebanon, the space between them being occupied by a longitudinal valley, known by the name of El Bekaa and anciently of Coele-Syria. It has a much lower average elevation than the Lebanon chain, the culminating point of this chain, which is Jebel-el-Sheik, about 30 miles west of Damascus, attaining a height generally estimated at 9000 feet, though some make it higher. This mountain, visible from almost all parts of Syria, forms an important landmark for the guidance of the caravans. The mountain-chain now described divides Syria into three regions—a western, consisting of a narrow belt of lowland extending between the sea and the mountains, sometimes sandy, but generally fertile; a central, occupied by the principal mountains of the chain; and an eastern, consisting for the most part of a bare, arid, sandy plateau, occasionally relieved by a few oases. The principal rivers are the Euphrates, confined to a part of the north-east frontier; and the Jordan or Ghor, which, rising on the north of Jebel-el-Sheik, continues its course almost due south, through a valley remarkable, particularly in its southern part, for its great depth beneath the level of the sea. In the course of the Jordan are the lakes of Merom and Tiberias, and at its mouth is the far larger lake of the Dead Sea. The climate of Syria is salubrious among the mountains, but excessively hot, unhealthy, and often pestilential along the seashores. Much of the soil, more especially in the valleys of Lebanon, is remarkable for its fertility; and if its natural advantages were not more than counteracted by its wretched political condition, it might easily, at least in its cultivable parts, be rendered one of the richest regions of the world. Among its principal products are corn, cotton, fruit in almost endless variety, indigo, sugar-cane, grapes, mulberries, olives, and tobacco. Its forests also are extensive, and include among their trees, though now only to a limited extent, the famous cedars of Lebanon. The chief domestic animals are camels, oxen, goats, sheep, mules, asses, and horses. Game is abundant; and the bees yield honey in such abundance, and of such excellent quality, as to form an important branch of rural economy. The minerals, as well as the general geology of the country, have been imperfectly explored; the only metal of any consequence appears to be iron, and coal is worked to some extent near Beyrout. Both manufactures and trade are in a very languishing condition. The former, once celebrated, are now confined to a few of the principal towns, among which may be mentioned Damascus, which is

still in some repute for its silks and other fabrics; silk is also manufactured at Aleppo and Beyrout; the other leading articles are cotton goods, soap, glass, and confectionery. The trade is chiefly confined to Alexandretta, Tripoli, and Beyrout, the last now connected by railway with Damascus and the Hauran, as the port of Jaffa also is with Jerusalem. The inhabitants, roughly estimated at about 3,000,000, consist chiefly of descendants of the ancient Syrians, Arabs, Turks, Greeks, and Jews; among the mountaineers the most celebrated tribes are the Druses and Maronites. There are also several nomad tribes, as Turkomans in the north, Kurds on the banks of the Euphrates, and Bedouins in the Syrian desert. The Turks and Arabs are Mohammedans; the Greeks generally belong to the Greek Church; the Maronites form a peculiar Christian sect. The language generally spoken is Arabic; the old Syriac or Aramaic tongue is spoken only by the Nestorians of Kurdistan; the Turkish government officials and soldiers use of course their own language. For administrative purposes Syria formerly composed the four pashaliks of Acre, Aleppo, Damascus, and Tripoli. At present, Syria in the widest sense comprises the vilayets of Syria proper (Palestine east of the Jordan, Damascus, &c.), Beyrout, Aleppo, and Zor (extending beyond the Euphrates), with the divisions of Jerusalem and Lebanon, the former a mutessarifate, the latter a privileged province.

Syria at an early period became part of the Assyrian Empire, and afterwards passed to the Persians under Cyrus, and the Greeks under Alexander. It next became the centre of the empire of the Seleucides, from whom it was conquered by the Romans, during whose domination Odenath and his celebrated queen Zenobia established a short-lived kingdom at Palmyra. On the division of the Roman Empire into a western and eastern, Syria fell to the latter, but was taken by the Arabs in 636. It was governed by caliphs till 883, and then passed under various masters till it was conquered by the Seljuk Turks in 1078. It was partly wrested from them by the Crusaders, who founded in it the kingdom of Jerusalem, which lasted till 1293. Syria was then taken by the Mamelukes, who united it with Egypt, and retained possession of it till 1517, when the Ottoman Turks added it to their empire. The most important events in the modern history of Syria are its conquest by Mehmet Ali in 1833, and its restoration to Turkey in 1840 by the intervention of the great European powers; and the war between the Druses and Maronites which broke out in 1860, peace being restored in 1861 only by the active efforts of a French force sent out under sanction of Turkey and the western powers.

#### SYRIAC LANGUAGE AND LITERATURE.

The Syriac language is a branch of the Aramaic tongue, and thus belongs to the Semitic family. Various forms of character are used in writing it, but they all spring from the same source from which the Hebrew alphabet originated. The Syriac language, as might have been supposed from the circumstance of the country being surrounded by powerful nations and developed civilizations, is less pure than the other dialects of the Semitic group. Greek and Latin words are occasionally met with. In tense forms the Syriac is richer than the sister tongues, but it has only three of the Semitic conjugations. The dual number in nouns as in verbs has disappeared. Ancient Syriac was a vernacular dialect during the early centuries of our era; it attained the rank of a literary language in connection with translations of the Bible and the spreading of Christianity. As a living language it ceased to be spoken about the tenth century, being crowded out by that of the Arabian conquerors. A

very corrupted form of it is spoken by a few scattered tribes, and principally by the Nestorians of Kurdistan and Persia. We have no evidence that a national literature existed before the introduction of Christianity. In the first century of our era, however, we can trace the beginnings of a literature, at first chiefly connected with theological and ecclesiastical subjects, Biblical translations and commentaries, hymns, martyrologies, liturgies, &c., but in course of time it embraced history, philosophy, grammar, medicine, and the natural sciences. The oldest work in the language still extant is the incomplete translation of the Bible called the Peshito. (See PESHITO and SYRIAC VERSIONS.) The earliest writers whose names with fragments of their works have come down to us are Bardesanes the Gnostic and his son Harmonius, who flourished about the end of the second century and the beginning of the third. In addition to their theological and philosophical writings they composed a number of hymns, rude and inharmonious it is true, but they were the first attempts to fix the poetic style of the language, and to give it a properly metrical form dependent on accent and number of syllables, with occasional rhyme. The most learned representative of the orthodox Syrian Church is undoubtedly Ephraem Syrus, or St. Ephraem, who flourished in the fourth century. The latest Syriac classic writer is Bar-Hebraeus, the Jacobite bishop of Maraga, who died in 1286. The greater part of this literature has been lost, but much valuable material still remains unedited. The Arabs may be said to have been the scholars of the Syrians in every department of knowledge, and the Arabic translations of Greek authors were probably made, at the outset at least, almost altogether from Syriac translations and by Syrian writers. The Arabs, however, soon surpassed their Syrian teachers, and became their instructors in turn, and in course of time the vigorous new Moslem literature succeeded in superseding that on which it was itself founded.

**SYRIAC VERSIONS OF THE BIBLE.** The Divine inspiration of the Scriptures was so universally and firmly held in the ancient Syrian Church that translations were made from it at very early periods. In addition to the Peshito Version (see PESHITO), which was recognized as the authorized version by all the various sects of the Syrian Church, there is one made in the beginning of the seventh century by Paul of Tella, a Monophysite, and which is based on the Hexaplar Greek Text,—that is, the Septuagint with the corrections of Origen, the asterisks, obeli, &c., and with the references to the other Greek versions. Only a very few MSS. of this version are extant and those are imperfect. Those best known are preserved in the Ambrosian Library at Milan, the British Museum, and the National Library at Paris. The majority of the biblical books have been edited from this version, but in separate publications. Its value for the criticism of the Septuagint is very great, supplying as far as a version can the lost work of Origen. The Peshito Version of the New Testament contains the four Gospels, the Acts of the Apostles, the epistles of Paul, the first epistles of John and Peter, and the epistle of James. It is supposed to have been translated from Greek into Syriac in the first or second century. Among the best texts is that of Buchanan and Lee, published by the British and Foreign Bible Society in 1816. Another version, translated by Polycarp under the auspices of Philoxenus, bishop of Hierapolis (488–518), hence called the Syro-Philoxenian Version, and revised by Thomas of Haraclaea in 616, is very inferior to the Peshito. Among the MSS. brought by him from Syria in 1842 Dr. Cureton discovered an imperfect copy of the Gospels, differing widely from

the common text, and which he supposed to belong to the fifth century. A more complete Syriac codex of the Gospels was discovered in 1892.

**SYRIAN CHRISTIANS,** that section of the Christian church which had its stronghold in Syria, and which was originally included in the Patriarchate of Antioch, and subsequently in that of Jerusalem. Up to the end of the fourth century the Syrian Church was in a very flourishing condition, having at that time a membership of several millions. But controversies soon arose on the incarnation, and the church split up into several sects, such as the Maronites in Lebanon, the Jacobites in Mesopotamia, the Christians of St. Thomas in India, and the Nestorians in Kurdistan. The term Syrian Christians is frequently specially applied to the latter community, as it is the name by which they choose to be known (Nesrāni Surjāni). For a considerable period the Roman Catholics have termed them Chaldeans or Chaldean Christians, a name still borne by the Nestorians who are in communion with Rome, and also by the United Jacobites. The liturgy of the church (known as the liturgy of St. James) is in Syriac, which is an unknown tongue to the people, and even to many of the priests themselves. The custom of fasting prevails among all the sects, the saints are invoked, and prayers are offered up for the dead; they use unleavened bread and administer the communion in two kinds; the use of graven though not of painted images is forbidden. Their priests may marry before ordination, but are not allowed to marry a second time. See EUTICHES, JACOBITES, MONOPHYTES, NESTORIUS.

**SYRINGE,** a small hydraulic instrument consisting of a cylinder of metal or glass fitted with an air-tight piston, which is moved up and down by means of a handle. In its simplest form it is destitute of valves, one simple aperture at the extremity serving for the admission and ejection of fluid; those provided with valves, however, are available, on a small scale, for all the purposes of an air-pump.

**SYRINX.** (See SPOON-WORM.) This name is also given to the lower larynx or true organ of voice in birds. See ORNITHOLOGY and SONG OF BIRDS.

**SYRTES,** two large gulfs of the Mediterranean on the coast of Africa. The Lesser Syrtis, or Gulf of Cabes, lies on the east coast of Tunis; the Greater Syrtis, or Gulf of Sirra, lies south-east from the former, between Tripoli and Barka. The navigation of the Syrtis was anciently considered very dangerous, their shores being inhospitable and full of quicksands, and their waters being dangerous owing to the presence of sandbanks, shallows, and sunken rocks.

**SYRUP,** a saturated, or almost saturated solution of sugar in water, either simple, flavoured, or medicated. In preparing syrups the best refined sugar should be used, and either distilled water or filtered rain water; they will thus be less liable to spontaneous decomposition, and will be transparent without undergoing the process of clarification. When vegetable infusions or solutions enter into the composition they should be made perfectly transparent by filtration or clarification before being added to the sugar. The proper quantity of sugar for syrups is about 2 lbs. for every pint of water. It is of great importance to employ as little heat as possible, as a solution of sugar, even when kept at the temperature of boiling water, undergoes slow decomposition. Syrups should be kept in a moderately cool, though not a cold place. Fruit-syrups are much used on the Continent for mixing with water, and make a wholesome refreshing drink. In Great Britain they are mostly used in medicine.

**SYZBAN,** or SEYSEBAN, a town of Central Russia, in the government of Simbirsk, and 78 miles south

of the city of that name, on a height above the Sysran and Krymza, both of which here join the Volga. Though, after Simbirsk, the best town in the government, it is poorly built, and has unpaved streets. It contains two wooden and eight stone churches and a monastery; and has manufactures of soap and leather, a fishery, and a trade in corn and cattle. Pop. (1897), 32,377.

SYZGY, the conjunction or opposition of any two of the heavenly bodies. See MOON.

SZATHMAR, or SZATHMAR-NEMETHI, a town of Hungary, capital of a county of the same name, in a marshy plain on the Szamos, 69 miles E.N.E. of Grosswardein. It was once fortified, and has some of its fortifications still remaining. It is very indifferently built, and has only its principal streets paved. It is the see of a Roman Catholic bishop; contains a cathedral, two Protestant and two Greek churches, a theological seminary, a Roman Catholic and a Protestant gymnasium, normal school, and Franciscan monastery. It has some manufactures, and has a considerable trade in corn, wine, brandy, fish, and wood. There are salt mines in the neighbourhood. Pop. (1890), 21,140; (1900), 26,881.

SZECHUEN. See SECHUEN.

SZEGEDIN, a royal free town of Hungary, capital of the county of Csongrad, in a marsh on the right bank of the Theiss, below the mouth of the Maros, 100 miles south-east of Budapest. On the 11th-12th of March, 1879, it was almost completely destroyed by an inundation of the Theiss, which broke its several lines of embankments, and drowned 2000 persons. Since then it has been protected by an inclosing embankment about 40 feet high, and has been rebuilt in an attractive style, having now fine broad streets and large squares lined with handsome houses and public buildings, a fine quay along the Theiss, &c. Its chief buildings, besides churches,

monasteries, and educational institutions, among the latter being included a public library of 80,000 vols., are the town-house, a large building with an imposing tower, the court-house, the post and telegraph offices, the theatre, prison, barracks, &c. The Theiss is spanned by two railway bridges and a fine iron bridge for general traffic. Szegedin has various industrial establishments, among others, extensive soap, cloth, and tobacco factories. The trade, which is important, is chiefly in tobacco, salt, wood, wool, corn, and cattle. A great many river boats are built here. Up to 1879 Szegedin was a fortress. Pop. (1880), 73,365; (1890), 87,992; (1900), 102,991.

SZENTA, or ZENTA, a market town of Hungary, in the county of Bacs, on the right bank of the Theiss, 10 miles south of Kis-Kanisa, in a beautiful plain. It is famous for the victory which Prince Eugene gained over the Turks in 1697. Pop. (1900), 28,588.

SZENTES, a town of Hungary, in the county of Csongrad, 29 miles N.N.E. of Szegedin, with a considerable number of well-built houses, a Protestant church with a handsome tower, three other churches, and a town-house; and a considerable trade in corn, cattle, and wood. Pop. (1900), 81,308.

SZEXARD, SEXARD, or SZEGSZARD, a market town of Hungary, in the county of Tolna, 81 miles south-west of Budapest, on the Sarviz, and not far from the Danube, from whose inundations it is guarded by large dikes. It is for the most part well built, and has an extensive silk-mill and a considerable general trade. Pop. (1890), 14,325; (1900), 13,895.

SZOLNOK, a market town of Hungary, in the county of Jászgyien, on the right bank of the Theiss. It was once defended by a citadel, which is now in ruins; contains a Franciscan monastery, now used as the church; and a Turkish mosque, converted into a chapel; and has a trade in fruit, wood, salt, and fish. Pop. (1890), 20,748; (1900), 25,379.

## T.

T, the twentieth letter in the English alphabet, representing the sound produced by a quick and strong emission of the breath after the end of the tongue has been placed against the roof of the mouth near the roots of the upper teeth. The strength with which the breath is emitted in pronouncing *t* is almost all that distinguishes this sound from that of *d*. *T* is therefore a lingual, or denti-lingual, and as such is allied to *d* and *th*; it is also a mute. As *d* and *t* are so nearly related it is natural that they should often take each other's places, as is the case also with *t* and *s*. One of the main differences between Lower and Upper German is that the Lower German almost invariably puts a *d* where the Upper German has a *t*. The compound English character *th* represents two simple sounds, as in *this* and *thing*; the former is a sound between *d* and *t*, and the latter between *t* and *s*; so that foreigners whose native language does not contain these sounds often say *dis* and *sing* for *this* and *thing*, or *noosing* for *nothing*. In Anglo-Saxon there were separate characters for these two sounds. The Greek theta, *θ* or *9*, was pronounced, according to some authorities, like the English *th* in *thing*; according to others it was a compound sound, the ordinary sound of *t* followed by the aspirate. The Latins, who had no such character, used the *th* instead, particularly in such words as were directly derived from the Greek. English is the only language

of the Germanic stock that has the hisping *th* sound, though some such sound seems to have existed in ancient German. In modern German *theit*, *thau*, and *ruthe* do not differ at all in sound from *teit*, *tau*, and *ruet*. *T* is used as an abbreviation on ancient monuments, &c., for *Titus*, *Titius*, and *Tullius*. As a numeral it signified 160; *T* with a dash over it, thus, *T̄*, signified 160,000. Among the Greeks, *τ* denoted 300, and *ϛ*, 300,000. The *𐤔* of the Hebrews signified 9, and with two points placed horizontally over it, thus, *𐤔̄*, it denoted 9000. *T* on French coins denotes the mint of Nantes. *T* is used also to denote things of this form, as a *T* bandage in surgery, one consisting of two bands which cross each other; or the *T* palace in Mantua. For the use of *T* in modern abbreviations see ABBREVIATIONS.

TABANUS. See GAD-FLY.

TABARD, a sort of tunic worn about the times of the Tudors over the armour, covering the body before and behind, and reaching below the loins, but open at the sides from the shoulders downwards; it had wide sleeves or flaps reaching to the elbow, and was generally embroidered with the arms of the wearer, or if worn by a herald, with those of his lord or sovereign. It still forms a part of the official dress of heralds.

TABASCO, a state of Mexico, bounded on the north by the Gulf of Mexico, east by Yucatan, south

by Chiapas, south-west by Oajaca, and north-west by Vera-Cruz. It is one of the smallest states of the confederation; length, east to west, about 200 miles; mean breadth, about 60 miles; area, 10,072 square miles. The surface consists almost entirely of a great flat, sloping gradually to the sea, but in many parts so low that it is subject to inundations. The streams, though numerous, are short and shallow, and are generally obstructed at their mouths by bars and flats. The climate is excessively hot, particularly along the coast, and owing to the flatness and swampiness of the surface, very unhealthy. A large portion of the state is still covered with primeval forests. The principal cultivated crops are cacao, coffee, pepper, sugar, palmetto, and some tobacco. The streams abound with fish, and the bees of the forests yield large supplies of honey and wax. The inhabitants are chiefly Indians. The capital is Villa-San-Juan-Bautista. Pop. of the state (1900), 158,107.

**TABASHEER**, or **TABASHIR** (Persian), a siliceous concretion resembling hydrophane, sometimes found in the joints of bamboos and other large grasses. It is highly valued in the East Indies as a medicine for the cure of bilious vomitings, bloody flux, piles, and the like, but its virtues are merely imaginary. Tabasheer has, according to Sir David Brewster, the lowest refractive power of all known substances.

**TABBY**, in commerce, a kind of rich watered silk which has undergone the operation of tabbying or being passed through a calender, the rolls of which are made of iron or copper variously figured, which, bearing unequally on the stuff, renders the surface unequal, so as to reflect the rays of light differently, making the representation of waves thereon.

**TABERNACLE** (Latin, *tabernaculum*, a tent), the name given to the tent or sanctuary, in which the sacred utensils were kept during the wanderings of the Israelites in the desert. It was in the shape of a parallelogram, 45 feet by 15, and 15 feet in height, with its smaller ends placed east and west, having its entrance in the east occupying the whole end, this entrance being closed by a splendid curtain supported by five columns. Its framework consisted of forty-eight gilded boards of shittim-wood (that is, the desert acacia, a light, close-grained, imperishable wood, easily taking on a fine natural polish), bound together by golden rings and set into silver sockets. This gilded frame was covered with four curtains; the interior was divided by a curtain into two compartments, the outer the 'sanctuary' proper, and the innermost the holy of holies. In the sanctuary was placed on the north the table of show-bread, on the south the golden candlestick, and in the middle, near the inner curtain, the altar of incense. In the centre of the holy of holies stood the ark of the covenant. The tabernacle was situated in a court 150 feet by 75, surrounded by costly screens  $7\frac{1}{2}$  feet high, and supported by pillars of brass  $7\frac{1}{2}$  feet apart, to which the curtains were attached by hooks and fillets of silver. This inclosure was broken on the eastern side by the entrance, which was 30 feet wide, and closed by curtains of fine twined linen of the most gorgeous colours. In the outer or eastern half of the court stood the altar of burnt-offering, and between it and the tabernacle itself the laver, at which the priests washed their hands and feet before entering the sanctuary. As long as Canaan remained unconquered the tabernacle was probably moved from place to place, wherever the host of Israel encamped. When the tribes were settled it rested at Shiloh, where it continued during the whole period of the judges. When the ark of God was taken in the time of Eli, the tabernacle lost almost all its glory. Samuel treated it as an abandoned shrine, and sacrificed at Mizpah, Ramah, and Gilgal. For a time

under Saul it seems to have been settled at Nob, and afterwards at Gibeon. On the erection of the temple at Jerusalem the tabernacle and all the holy vessels were removed to it, together with the ark, which had remained for some time at Kirjath-jearim.

**TABERNACLE**, in the Roman Catholic Church, is the receptacle in which the host is kept on the altar. It is made of costly material (metal, marble, or some fine wood) and workmanship, and in form somewhat like the Jewish tabernacle. It is always carefully locked up, and the key is never intrusted to the keeping of any lay person whatsoever.

**TABERNACLES, FEAST OF**, the last of the three great festivals of the Jews which required the presence of all the people in Jerusalem. Its object was to commemorate the dwelling of the people in tents or booths during their sojourn in the wilderness, and it was also a feast of thanksgiving for the fruits of the field—corn, wine, and oil. The time of the festival fell in the autumn, when all the chief fruits were gathered in (hence it is often called the feast of ingathering), and began on the fifteenth day of the seventh month (Tishri = October). Its duration was strictly only seven days, but it was followed by a day of holy convocation of peculiar solemnity. During the seven days the Israelites were commanded to live in booths made of olive, pine, palm, myrtle, and other branches; these were erected in the courts of houses, on the roofs, and in the court of the temple. It was the most joyous festival of the year. Early in the day each Israelite, dressed in holiday attire, with palm and other boughs in their hands, marched to the temple, where the morning sacrifice was offered up, and water was brought by the priest from the pool of Siloam, and poured out with the accompaniment of vocal and instrumental music and the waving of the boughs. In the evening both men and women assembled in the court of the women, and engaged in dancing and singing; the whole city was lighted up with the great lamps of the temple court, those in the courts of the women, and the torches of processionists.

**TABINET**, a rich fabric consisting of a warp of silk and a weft of wool, usually ornamented with diaper patterns. It resembles in appearance fine damask, and is employed for window curtains.

**TABLE, ROUND.** See **ROUND TABLE**.

**TABLEAUX VIVANTS** (French = 'living pictures') are representations of scenes from history or fiction by means of persons grouped in the proper manner, placed in appropriate postures, and remaining silent. They are supposed to have been first introduced by Madame de Genlis, instructress of the children of the Duke of Orleans. They were at one time popular in theatres, and have now become a source of amusement in private circles.

**TABLE-LAND**, or **PLATEAU**, any flat or comparatively level tract of land considerably elevated above the general surface of a country. Being in effect broad mountain masses, many of these plateaux form the gathering-grounds and sources of some of the noblest rivers, while their elevation confers on them a climate and a vegetable and animal life distinct from that of the surrounding lowlands. In the torrid zone the higher plateaux afford the climate and produce of temperate regions, and in the temperate zones they assume the characteristics of polar latitudes. In Europe the chief table-lands are those of Castile in Spain, having an elevation of from 2000 to 2300 feet, and traversed by hilly ridges (*sierras*) that give great diversity to the surface; the less defined upland of Switzerland, with an elevation of from 3000 to 4000 feet; and the lower plateaux of Bavaria and Bohemia. In Asia we have first the table-land of Persia, 2300 to 3500 feet high, and

upwards of 800,000 square miles in extent; higher in altitude the sandy rainless Desert of Gobi, 4000 to 6000 feet high, and nearly 400,000 square miles in extent; and lastly the still loftier plateau of Tibet, the highest inhabited region of the world, with an elevation of from 11,000 to 15,000 feet and an extent of 166,000 square miles. Besides these great central uplands there are in Asia the lateral and more isolated plateaux of the Deccan, of Arabia, of Armenia, and of Ust Urt between the Caspian and Aral seas. In Africa there are the plateaux of Abyssinia, and the karoo or terrace plains of South Africa. Inland from the coast of Congo and Loango the country assumes the character of a lofty tableland, and much of the Desert of Sahara is of a flat elevated nature, from 1500 to 4000 feet above sea-level. In America there are the great table-lands of Mexico, 4000 to 8000 feet high; of Bolivia, 11,000 to 12,500 feet; of the interior of Brazil, with a mean altitude of 3000 feet; the saline desert of Utah, and the highlands of Oregon, with an elevation of 4000 to 5000 feet.

**TABLE MOUNT**, a mountain of South Africa, south of Table Bay, its highest point being right over Cape Town. It is about 3500 feet high, level on the top, and falls down nearly perpendicularly at the east end till it joins the Devil's Mount, a rugged peaked mountain nearly as high as the former, and separated from it by a small gap. The west end of Table Mount is also nearly perpendicular a considerable distance downward, and then has an abrupt declivity till it joins the base of another mount called the Sugar Loaf or Lion's Head, which is about 2100 feet high. The mountain owes its name to its peculiar shape and flattened summit.—**TABLE BAY**, an inlet of the Atlantic, lies to the north of the above mountain. It is 6 miles wide at the entrance, and capable of sheltering the largest fleet. It is well protected from the prevailing south and south-east winds.

**TABOO**, a word significant of a peculiar custom prevalent among the South Sea Islanders, and used in general to denote something consecrated, sacred, forbidden to be touched, or set aside for particular uses or persons. It is applied both to persons and things, and both to the object prohibited and to the persons against whom the prohibition extends. Thus a consecrated piece of ground is *taboo*, the act of consecrating it is called *taboo*, and the persons who are excluded from entering are also said to be *tabooed*. It is taboo for any inferior to touch the body of a chief living or dead, or anything belonging to him; to eat in his presence, or anything he has touched; to cross his threshold otherwise than on the hands or knees, or to mention his name. A particular article of food is sometimes tabooed at a certain season in order to preserve it against a season of scarcity, &c. In the case of a serious infringement of the taboo the punishment is death; in less heinous cases a sort of outlawry, the neighbours being permitted to appropriate or destroy the offender's goods.

**TABOR** (now called *Jebel et Târ* or *Jebel Tor* = the Mountain), one of the most remarkable and interesting hills of Palestine, rises abruptly in the shape of an almost perfect cone from the north-eastern arm of the plain of Esdraelon to a height of nearly 1000 feet. It is clothed with woods to the

very top; the dark-green of the walnut, the rose-bushes, the yellowish-white styrax blossoms, the pistacia and oak trees—all these and many others beautify the path to the summit, where a view of immense extent is obtained, embracing Galilee, Samaria, Perea, and reaching as far northward as the snow-crowned Hermon. The coverts afford a shelter for wolves, wild boars, lynxes, and various reptiles. The isolation of this mountain doubtless led to its being made by the earlier ecclesiastics the scene of the transfiguration. The historical data which we possess, however, show that its summit was employed without intermission between the times of Antiochus Magnus (218 B.C.) and the destruction of Jerusalem under Vespasian as a stronghold. There are some architectural remains still to be seen on the summit.

**TABOR**, a town of Bohemia, on an eminence above the Litschnitz, 48 miles S.E. of Prague. It is walled; has a handsome Gothic church, a deanery church, and a castle, built by the celebrated Hussite chief Ziska. This castle was a stronghold of the sect of the Hussites called Taborites, and makes a conspicuous figure in their history. Pop. (1890), 8451.

**TABORITES**. See **HUSSITES**.

**TABREEZ**, or **TABRIZ** (the ancient *Tauris*), a city of Persia, capital of the province of Azerbaijan, on the left bank of the Aigz, 36 miles above its entrance into Lake Urumia. It lies at the inner extremity of an amphitheatre, about 4000 feet above sea-level, with hills on three sides, and an extensive plain on the fourth. It is surrounded with a wall of sun-dried brick, with bastions, and entered by seven or eight gates. A large portion of the population resides outside the walls, and the plain around is covered with gardens, producing the finest fruits in the greatest abundance, particularly grapes. The citadel is the most conspicuous building in the city. It was originally a mosque, and is 600 years old. It consists of a lofty edifice of brick, and though much damaged by earthquakes, is still a noble structure. Within the walls of the citadel there are a cannon-foundry and barracks. The most interesting building in the town is the fine ruin Kabûd Masjid (Blue Mosque), which is about 300 years old, and is partly covered with arabesqued tiles. A considerable trade is carried on in the import of European goods and sugar, the former consisting mostly of cotton manufactures, principally British, petroleum from Russia, and woollen goods, chiefly from Austria and France; and in the export of raisins and other fruits, leather, carpets, silks, skins, cottons, shawls, tea, &c., principally to Russia and Turkey. In the year 1900-1901 the imports amounted to £1,204,070, and the exports to £649,415. Though still an important city, Tabreez has greatly degenerated from what it was in ancient times; the glowing descriptions of old travellers, who speak of its splendid cafés and its hundreds of caravansaries and mosques, being no longer applicable; while its immense population of 550,000, according to ancient writers, has dwindled down to about 165,000. The city has been repeatedly devastated by earthquakes, the most destructive visits being those of the years 858, 1041, and 1721, on which last occasion 80,000 persons are supposed to have perished. The principal manufacture is that of carpets.

## SUPPLEMENT.

**SELMA**, a city of the United States, in Alabama, on the Alabama river, 95 miles below Montgomery, and at the head of the steam navigation of the river. It has mills and various manufactories. It is situated in an important cotton district, and carries on a considerable trade in cotton, coal, iron, and lumber. During the civil war it was an important military station. Pop. (1890), 7622; with suburbs, now about 15,000.

**SELOUS, FREDERICK COURTNEY**, hunter and traveller, was born in London on Dec. 31, 1851, his father being of mixed French and English parentage. After being educated at Tottenham and at Rugby, he spent some time on the Continent. In 1871, before completing his twentieth year, he went to South Africa, and began his career as a hunter of big game, an explorer, and a naturalist. In 1881 he published his first book, *A Hunter's Wanderings in Africa*: being a Narrative of Nine Years spent amongst the Game of the far Interior of South Africa (2nd edn., 1890). This work attracted instant attention, and secured for him several distinctions from the Royal Geographical Society, including the founder's gold medal, and also election as a corresponding member of the Zoological Society. In 1890 he entered the service of the recently-formed British South Africa Company, and he acted as guide to the expedition which effected the occupation of Mashonaland. He subsequently served in the campaigns of 1893 and 1896 against the Matabele. His remaining publications are: *Travel and Adventure in South-East Africa*, a narrative of eleven years spent on the Zambesi and its tributaries, with an account of the colonization of Mashonaland, &c. (1893); *Sunshine and Storm in Rhodesia* (1896); *Sport and Travel, East and West* (1900).

**SELVAS.** See **SILVAS**.

**SEMAO.** See **SSUMAO** in **SUPP.**

**SEMIRETCHENSK**, a province of Russian Turkestan, area 152,280 square miles. It is mountainous in the south, being traversed by the various branches of the Ala-tau range and by spurs of the Thian Shan; but the northern part is flat and barren. It is watered by the Ili, the Chu, and many other rivers, and contains many lakes, including Balkhash, Issik-kul, Ala-kul, and Sasik-kul. Large numbers of cattle and sheep are reared by the inhabitants, and agriculture is more or less developed in the southern district. Horses and camels are also reared. Pop. (1897), 990,107.—The chief town is **VERNOYE**, which has an increasing trade with Kuldja and Kashgar. Pop. 12,000.

**SENDAI**, an important market-town of Japan, near the east coast of Hondo, 190 miles north by east of the capital. It is situated some 12 miles from its port Shiovogama on Sendai Bay, and carries on a large trade in fish and salt. Pop. (1899), 83,325.

**SENECA FALLS**, a town of the United States, Seneca county, New York, on the Seneca River,

which flows from Seneca Lake to Cayuga Lake, 16 miles west of Auburn. It is now a favourite summer resort. The beautiful falls on the river afford excellent water-power. There are manufactures of fire-engines, pumps, woollens, &c. Pop. (1890), 6116.

**SEOUL**, or **SOUL**, the capital of Corea, on the river Han, about 70 miles (by water) from its mouth in the Yellow Sea. The city proper is a short distance from the river, in a basin partly surrounded by heights, and is enclosed by a wall. The streets are narrow and dirty, the houses low and mean, even those of the higher classes, though these are built in open areas surrounded by walls. The royal palace is the chief edifice, and with its grounds occupies a large space, which is inclosed by a lofty wall. As the seat of government Seoul is the place where the representatives of the various foreign powers reside. It is connected with all the open ports of Corea by telegraph, and with Chemulpo by railway. Pop. about 150,000, or with the very extensive suburbs, 300,000. The foreign population in 1900 numbered 4102, mostly Japanese and Chinese.

**SERIPHOS**, or **SERPHO**, a small rocky island belonging to the Greek Cyclades, some 50 miles south of Eubrea. It yields some corn and wine, and iron ore of good quality is mined. It furnished several vessels to the Athenian fleet in the battle of Salamis, and was used as a place of exile by the Romans. Pop. about 3000.

**SETIF**, a town in the Algerian department of Constantine, some 40 miles south-east of Bougie, connected by rail with Algiers, Constantine, and Philippeville. It is an important market-town, and carries on a considerable trade in grain, cattle, leather, &c. It has remains of a Roman town and of an ancient citadel. Pop. in 1896, 16,081.

**SEWELLEL** (*Haplodon rufus*), a peculiar rodent mammal of North America, confined to a small area in the states of Washington, Oregon, and California. It has affinities with the beaver and with the marmota, but is regarded as constituting a distinct family, *Haplodontidæ*. In size and general appearance it is not unlike the musk-rat, but it has almost no tail. Its colour is mostly brownish, with gray underparts. It burrows underground, and feeds upon various vegetable substances. It is also called the *boomer* and *mountain beaver*.

**SFAX**, a town on the east coast of Tunisia, situated opposite Kerkenna Island on the north of the Gulf of Gabes. It is surrounded by walls and bastions, and has a strong citadel. It is one of the chief ports of Tunisia, and exports large quantities of fruit (especially dates), wool, sponges, alfa, &c. A harbour was constructed in 1897, and a railway to the interior has been built. Sfax was captured by the French after a two days' bombardment on July 16, 1881. Pop. 15,000.

**SHAFTESBURY**, **ANTHONY ASHLEY COOPER**, SEVENTH EARL OF, English philanthropist, was born

in London on April 28, 1801, being the eldest son of the sixth earl. He was educated at Harrow and Christ Church, Oxford, and sat in the House of Commons during most of the period from 1826 to 1851, as member successively for Woodstock, Dorchester, Dorsetshire, and Bath, but in the latter year he succeeded to the peerage. He supported the administrations of Liverpool and Canning, and in 1828 he was appointed a commissioner of the board of control. Six years later he became a lord of the admiralty under Sir Robert Peel. From 1828, when he was appointed a member of a committee of inquiry into the treatment of lunatics, he constantly strove to improve the lunacy laws and administration; and it is largely due to his efforts that most of the worst abuses have been removed. But his name must ever be chiefly associated with his noble and successful efforts to improve the condition of factory workers. About 1833 he first proposed the limitation of their working-day to ten hours, and in spite of the opposition of the Manchester school of economists of the great capitalists, and even of the church to a large extent, his proposal became law in 1847. Five years before, he had succeeded in passing a bill which removed some of the most glaring cruelties perpetrated on women and children in the mines, and on several subsequent occasions he secured further reforms in the same direction. He also succeeded in abolishing by Act of Parliament the climbing-boy system employed by chimney-sweepers. Though a Conservative, he supported the repeal of the corn-laws. For thirty-nine years he acted as chairman of the Ragged School Union, and he was also identified with various movements for securing better house accommodation for the working-classes. He was president of the Bible Society, of the Pastoral Aid Society, of the Protestant Alliance, and of other religious organizations. He was an ardent evangelical in religious matters, and opposed to rationalistic beliefs and ritualistic practices. He died Oct. 1, 1885. See *Life and Work of the Earl of Shaftesbury* (1887), by Edwin Hodder.

**SHAIRP, JOHN CAMPBELL**, poet and miscellaneous writer, was born at Houstoun House, Linlithgow, on July 30, 1819, and died at Ormsary, Argyllshire, on Sept. 18, 1885. He was educated at Edinburgh Academy, Glasgow University, and Balliol College, Oxford, and numbered among his fellow-students Norman Macleod, Arthur Hugh Clough, Lord Coleridge, and John Henry Newman. In 1842 he carried off the Newdigate prize for a poem on Charles XII. After a term as assistant-master at Rugby he was appointed professor of humanity in the united College of St. Salvador and St. Leonards at St. Andrews in 1861, becoming principal in 1868. From 1877 he also held the chair of poetry at Oxford. In 1884, on the occasion of the tercentenary celebration in Edinburgh University, he received the degree of LL.D. His works consist of *Kilmahoe, a Highland Pastoral*, and other Poems (1864); *Studies in Poetry and Philosophy*, including essays on Wordsworth, Coleridge, and Keble (1868); *Culture and Religion* (1870); *Life and Letters of J. D. Forbes* (1873), with Prof. Tait; *Poetic Interpretation of Nature* (1877); *Burns, in the Men of Letters Series* (1879); and *Aspects of Poetry* (1881). Posthumous collections are: *Sketches in History and Poetry* (1887), edited by the late Prof. Veitch; and *Glen Dessaray and other Poems* (1888), edited by F. T. Palgrave. See *Principal Shairp and his Friends* (1888) by Professor Knight.

**SHALE**, a term applied in geology to all argillaceous strata which possess to a greater or less degree the quality of splitting into layers parallel to the planes of deposition. It is the solidified mud of

ancient waters, and is various in colour and composition, the chief varieties being sandy, calcareous, purely argillaceous, and carbonaceous. Shale is frequently found deposited between seams of coal, and commonly bears fossil impressions. The variety known as bituminous shale burns with flame, and yields an oil, mixed with paraffin, of great commercial importance. (See **PARAFFIN**.) Alum is also largely manufactured from the shales of Lancashire, Yorkshire, and Lanarkshire.

**SHALLOT**, a plant, the *Allium ascalonicum*, a species of onion, the mildest cultivated. It is sufficiently hardy to endure the severest winters of England. The shallot is used to season soups and made-dishes, and makes a good addition in sauces, salads, and pickles.

**SHANKLIN**, a town and watering-place of England, on the east coast of the Isle of Wight, 8 miles south-east of Newport, partly at the foot of high cliffs, but chiefly on elevated ground. It has a church dating from the reign of Stephen; literary institute, libraries, hotels, boarding-houses, &c., and railway and steamboat facilities. The celebrated Shanklin Chine is a deep and picturesque chasm in the cliffs near the town. Pop. (1891), 3921; (1901), 4533.

**SHARI**, a large river in Central Africa, which enters the southern side of Lake Tchad by several mouths after a course of about 700 miles from the south-east. See **TCHAD**.

**SHARP, WILLIAM**, a celebrated English line engraver, was born in London on Jan. 29, 1749, and died at Chiswick on July 25, 1824. He first practised as a writing engraver, but ultimately followed the higher branches of his art with great success. His merit was first recognized in connection with the engraving of Stothard's designs for the *Novelist's Magazine*, and his chief works of large size are from paintings by Copley, West, Reynolds, Raeburn (Portrait of Lord Dundas), Stothard, Romney, Salvator Rosa, Annibal Carracci, Guido, Domenichino, and Van Dyck.

**SHARPE, RICHARD BOWDLER**, ornithologist, was born on Nov. 22, 1847, in London, where his father was publisher and editor of Sharpe's London Magazine. Educated at the grammar-schools of Peterborough and Loughborough, he became in 1866 librarian to the Zoological Society of London, and held that office till his appointment in 1872 as senior assistant in the zoological department of the British Museum. Since 1895 he has been an assistant keeper in the sub-department of Vertebrata. He has published several important works dealing with birds, of which we may mention: *A Monograph of the Alcedinidæ (Kingfisher Family)*; *Birds in Nature* (1889); *British Birds and Birds' Eggs* (1891); *Review of Recent Attempts to Classify Birds* (1891); *British Birds* (1894), in Allen's *Naturalist's Library*, of which he was general editor; &c. He has also completed works left unfinished by Gould, to whose ornithological writings he has published an analytical index (1893). He has edited and written about half of the great *Catalogue of the Birds in the British Museum*. He is a member of many scientific societies, and is LL.D. of Aberdeen University.

**SHEBOYGAN**, a town and port of the United States, in Wisconsin, capital of a county of the same name, on Lake Michigan, at the mouth of the Sheboygan River, 137 miles north of Chicago. It is a busy place, with a large trade in wheat, lumber, coal, tan-bark, &c., and contains manufactories of various kinds, especially of chairs and other furniture. It has an excellent harbour, docks, shipyards, and large warehouses. Pop. (1890), 16,359.

**SHEEP'S-HEAD**, the name of a fish (*Archosargus* or *Diplodus probatocephalus*) of the family Sparidae, caught on the shores of Connecticut and Long Island. It is allied to the gilt-head and the bream, and is considered a delicious food. It is a stout, deep-bodied fish, with eight vertical dark bands, and may attain a length of 2½ feet. It receives its name from the resemblance of its head to that of a sheep.

**SHEEP-TICK**, a well-known dipterous insect (*Melophagus ovinus*) belonging to the family Hippoboscidae or horse-flies. It is a pupiparous insect, the pupæ being shining oval bodies which become attached to the wool of the sheep. From these issue the tick, which is horny, bristly, of a rusty-ochre colour, and wingless. It fixes its head in the skin of the sheep, and extracts the blood, leaving a large round tumour. Sheep-dips are used to destroy them. It is called also *sheep-louse*.

**SHEMAKHA**, a town of Russia, in Transcaucasia, about 70 miles north-west of Baku. In recent times it has suffered severely from earthquakes, and in 1902 it was almost totally destroyed by one. Silk manufacture is the principal industry. It has a considerable trade. Pop. 25,000.

**SHEPHERD'S PURSE** (*Capsella Bursa-pastoris*), a plant of the natural order Cruciferae, belonging to the division Siliculose. It is an annual weed, found in all temperate climates, having simple or cut leaves and small white flowers. The flowers are succeeded by small heart-shaped pods (silicles) containing several seeds. In Britain it occurs in all situations up to 1200 feet.

**SHERBROOKE**, a town of Quebec province, Canada, capital of a county of the same name, about 80 miles east of Montreal, on both sides of the river Magog. It is a flourishing place, with manufactures of tweeds and other industries, for which its extensive water-power is utilized. Pop. (1891), 10,110; (1901), 11,765.

**SHERBROOKE**, ROBERT LOWE, VISCOUNT, was born on December 4, 1811, at Bingham, Notts, where his father was rector. He was educated at Winchester, and at University College, Oxford, where he graduated with honours in 1833, and for several years was a private tutor. In 1835 he was elected a fellow of Magdalen, but in the following year he lost his fellowship by marriage. He now engaged in the study of law, and in 1842 was called to the bar as a member of Lincoln's Inn. Thinking that the colonies seemed to offer a field for his abilities the young barrister emigrated to Sydney, where he soon became a member of the Legislative Council. As member for Sydney he took a leading part in framing a new constitution for the colony, and laid the foundation of its educational system. In 1851 he returned to England, and was elected for Kidderminster in the Liberal interest. He first became prominent in parliament by an attack on Mr. Disraeli's budget for 1852, and when the Derby administration was overthrown Lowe was appointed by the new government to the post of joint-secretary to the Board of Control (1852-55), vice-president of the Board of Trade and paymaster-general (1855-58), and (in a new parliament, as member for Calne) vice-president of the Education Committee (1859-64). In the latter year he resigned his position, owing to his defeat in the House of Commons on an educational question, and for some years he remained out of office. In 1866 he gave a strenuous opposition to Lord Russell's bill for an extension of the franchise, and published his speeches on the reform question in 1867. In the following year Lowe was elected for London University, and became Chancellor of the Exchequer in the Gladstone administration. He showed considerable ability as

a financier; but his proposal to tax matches (in 1871) was withdrawn amid the gibes of the opposition and the clamour of the people. He resigned his office in 1873 and was appointed Home Secretary, a post in which he remained until his party retired in 1874. When the Liberals again returned to power in 1880 he was raised to the peerage under the title of Viscount Sherbrooke. For some years before his death, which occurred on July 27, 1892, he had ceased to take part in public affairs. In 1884 he published a volume entitled *Poems of a Life*. See *Life and Letters of Robert Lowe, Viscount Sherbrooke* (two vols., 1893), by A. Patchett Martin.

**SHERIDAN**, PHILIP HENRY, American general, and the greatest cavalry leader produced by the American civil war, was born at Albany, New York, on March 6, 1831, and graduated at the Military Academy, West Point, in 1853. In that year he was appointed to the brevet rank of second lieutenant in the First Infantry, and from 1855 to 1861 he served on the frontiers of Texas and Oregon. At the outbreak of the civil war he was a captain in the 13th Infantry. Having greatly distinguished himself in the earlier battles of the war at Murfreesboro, Chickamauga, and Chattanooga, in April, 1864, Grant, on his promotion to the rank of lieutenant-general, appointed him chief of cavalry of the Army of the Potomac, and he made several daring cavalry raids into the South. His rush from Winchester to Cedar Creek, a distance of 20 miles, in Oct., 1864, which turned a Federal defeat into a brilliant victory, is known as 'Sheridan's Ride'. During the final advance upon Richmond he was Grant's right-hand man: he fought the battle of Five Forks, which necessitated Lee's evacuation of Richmond and Petersburg; and as Lee fled he constantly harassed and attacked him until he compelled his surrender at Appomattox Court-house, April 9, 1865. After the war he held various military commands. In March, 1869, he became lieutenant-general, and in Feb., 1884, on the retirement of Sherman, he succeeded to the command of the army. He died at Nonquitt, Massachusetts, on Aug. 5, 1888. Sheridan was one of the greatest soldiers of the war, and though often placed in perilous positions he never lost a battle. An account of his military career, written by himself, appeared in 1889.

**SHERMAN**, a city of the United States, capital of Grayson county, Texas, 67 miles north of Dallas. It is the centre of a cotton, grain, and fruit district, and less than fifty miles from it are extensive coal-fields. It contains large cotton-seed-oil mills; flour, saw, and planing mills; foundries, marble-works, &c. Pop. (1890), 7335.

**SHERMAN**, WILLIAM TECUMSEH, an American general, was born at Lancaster, Ohio, on Feb. 8, 1820. He entered as a military cadet at West Point, where he graduated in 1840, and received his commission as second lieutenant in the artillery. In this capacity he took part (1841) in a war against the Indians of Florida, and served in California during the Mexican war (1846), for which he was brevetted captain. During the ensuing time of peace he resigned his commission, and became successively a banker, a lawyer, and a superintendent of a military academy. At the outbreak of the civil war in 1861 he was appointed brigadier-general of volunteers by the U.S. government, soon after the battle of Bull Run, in which he took part; and being sent into Kentucky, he demanded a force of 200,000 men to meet the enemy in that region. As this large demand seemed folly to the authorities at Washington, Sherman was deposed, but afterwards

received command of a division in the army of the Tennessee, and contributed greatly to the success of the battle of Shiloh (April 6 and 7, 1862), where he was wounded. His valuable services on this occasion having been officially reported by General Grant, he was appointed major-general of volunteers, and held command in Memphis during the preparations for an advance on Vicksburg. In the successive attacks upon that fortified town Sherman played a conspicuous part as commander of the 15th corps, and when at length the place was captured (July 4, 1863), he was appointed brigadier-general in the regular army. In the advance which followed, Sherman had command of the left wing at the famous battle of Chattanooga (23rd to 25th November), where his stubborn resistance to the Confederate attack secured a great victory for General Grant. In the following spring (1864) Grant was appointed commander-in-chief, and he at once gave Sherman command of the whole south-west, with orders to advance against Atlanta. With his force of 100,000 men and 250 guns he hemmed in the army under General Johnston, and finally captured the city of Atlanta (September 2). After a short stay in Atlanta to recruit, Sherman started with 65,000 men upon his famous march to the sea. Having covered about 300 miles in twenty-four days, in his advance through the enemy's territory, he arrived at Savannah on December 10, and in ten days the town surrendered. In the beginning of February he returned northwards through Carolina, compelled the evacuation of Charleston by a flank movement, fought a series of obstinate battles, and arrived in time to offer his services to Grant in his attack on Richmond, where General Lee was entrenched. The latter, however, surrendered (April 9), and in a few days afterwards General Johnston made terms with his opponent Sherman, whereupon the Confederate forces were disbanded and the long war was at an end. Subsequently, when Grant was made president, Sherman was appointed commander of the army, a post which he retained until 1884. He died at New York, Feb. 14, 1891. In 1875 he published his own *Memoirs* (two vols.), of which a revised edition was published the year after his death.

**SHIFFNAL**, or **SHIFNAL**, formerly *Idesall*, a market-town of England, in Shropshire, 17 miles east of Shrewsbury. It is a place of great antiquity, picturesquely situated, and has a fine old church. There is a chain-factory and an iron-foundry. It is supplied with good water from an artesian well. Pop. (1891), 3531; (1901, dist.), 8007.

**SHILDON**, a market town of England, in Durham, 3 miles south by east of Bishop Auckland, in a locality containing collieries, iron-works, and the extensive engine and wagon works of the North-Eastern Railway. Pop. (1891), 9537; (1901), 11,759.

**SHILLONG**, a town of India, in the Khasi and Jaintia Hills District, the administrative capital of the province of Assam, on the Brahmaputra. It is a sanatorium, being situated on a table-land 4900 feet above sea-level, between the Brahmaputra and Surma valleys. Pop. (1891), 6720, now rapidly increasing.

**SHIMONOSEKI**. See **SIMONOSEKI**.

**SHINTOISM**, one of the two great religions of Japan. In its origin it was a form of nature worship, but the essence of the religion is now ancestor worship and sacrifice to departed heroes. The sun as supreme god was regarded as the founder of the imperial dynasty. It is also known as *Sintuism*.

**SHIP-CANAL**, a canal for the passage of seagoing vessels. Ship-canal are intended either to make an inland, or comparatively inland place, a

seaport, or to connect sea with sea and thus obviate a long ocean navigation. Of the former kind are the Manchester Ship-Canal, making that city a seaport, and the Amsterdam Canal, which gives Amsterdam a direct passage to the North Sea at Ymuiden. Of the latter kind are the Suez Canal, the Caledonian Canal, the North Sea and Baltic Canal, and (not yet completed) the Panamá Canal, Nicaragua Canal, &c. The Caledonian Canal was formed by the British government for military purposes. It is a good example of a ship-canal which traverses high districts and surmounts the elevation by locks. The Suez Canal (1860-69) is the greatest of all ship-canal yet complete. It has no locks whatever, and communicates freely with the sea, connecting the Mediterranean with the Red Sea, and greatly reducing the length of the voyage from London to India. See the separate articles.

**SHIPKA PASS**, a pass in the Balkans, between Bulgaria and Eastern Roumelia, some 87 miles to the south-west of Rustchuk, about 4600 feet above the sea, the scene of a desperate and bloody ten days' struggle during the Russo-Turkish war (August and Sept. 1877). In his futile endeavours to take Fort Nicholas at the summit of the pass from the Russians, Suleiman Pasha lost 20,000 of his best men.

**SHIPLEY**, a town in the West Riding of Yorkshire, England, 3 miles north from Bradford, of which it is practically a suburb, on the river Aire. There is a large parish church in the Gothic style. There are factories for the manufacture of worsted. Pop. (1891), 23,387; (1901), 25,570.

**SHIP-RAILWAY**, a railway for transporting vessels from one body of water to another without shifting their cargoes. No such railway is yet in operation. A ship-railway was begun to be constructed in 1888, by the aid of the Canadian government, between Chignecto Bay, an extension of the Bay of Fundy, across the Chignecto Isthmus to Northumberland Straits, a distance of 17 miles. This will enable vessels to go from Prince Edward Island to St. John, New Brunswick, in twelve hours, and will be a great convenience for vessels coming from the St. Lawrence and the great lakes to St. John and the New England ports, which otherwise would have to go through the Gut of Canso or round Cape Breton. The vessels will be raised by hydraulic pressure a height of 40 feet to the level of the railway, and placed on a double track 18 feet from centre to centre, without disturbing their cargoes or passengers. The ship will be conveyed on a long carriage or cradle, and the immense weight will be distributed over many wheels, the car being hauled by two locomotives placed side by side. This railway has not yet been completed. The flexible-car system of ship-railway, proposed by William Smith, harbour engineer of Aberdeen, is designed to allow of the use of ordinary railway gradients. The car would be in sections, each carried on a compound bogie running on parallel lines. Vertical and lateral flexibility would be secured, and the ship sustained on the car by water-cushions, so as to be virtually kept floating. The ship would be raised on to the cars by means of a submerged shipway inclosed within a wet-dock.

**SHOEBURYNESS**, an urban district of Essex, on the estuary of the Thames, opposite Sheerness and 45 miles east of London. A school of gunnery is maintained here for the purpose of giving practical instruction to officers and men of the artillery, and carrying on all experiments in artillery and stores. Pop. (1891), 2990; (1901), 4065.

**SHOLAPUR**, chief town of Sholapur District, Bombay Presidency, India, 150 miles by rail from

**Poona.** Its situation between Poona and Haidarabad has made it, especially since the opening of the railway in 1859, the centre for the trade of a large extent of country. Its chief industry is the manufacture of silk and cotton cloth. Sholapur was stormed by General Munro in 1818, when the whole of the Peshwa's territories were incorporated in the Bombay Presidency. Pop. (including cantonment), (1891), 61,915; (1901), 75,288.

**SHOREDITCH**, a parish and parliamentary borough of Middlesex, in the east of London, about 1½ mile to the north-east of St. Paul's. It has manufactures of furniture, boots and shoes, dry-saltries, &c. It was made a parliamentary borough in 1885, with two divisions—Horton and Haggerston—one member for each division. Area, 648 acres; pop. (1891), 124,009; (1901), 117,898. Shoreditch is also a metropolitan borough under the recent London Government Act. Pop. in 1901, 118,705.

**SHORTHOUSE**, **JOSEPH HENRY**, novelist, a native of Birmingham, was born on Sept. 9, 1834, and was educated privately. He is engaged in the manufacture of sulphuric acid. His reputation rests upon one book, *John Inglesant* (1881), a romance of the Stuart period, which excited a great amount of interest on its appearance. Among his later works are *Sir Percival*, a Story of the Past and Present (1886), and *Blanche*, Lady Falaise (1891).

**SHOSHONG**, a town in the British protectorate of Bechuanaland, South Africa, about 400 miles north of Kimberley. It was at one time the capital of the Bechuana chief Khama, but after Bechuanaland became a British protectorate it was abandoned in favour of Palapye. Both are on the route from Cape Town and Kimberley to Buluwayo. Shoshong is the largest native town south of the Zambesi.

**SHOTTS**, a large parish of Scotland, in Lanarkshire, containing the villages of Harthill, Dykehead, Cleland, &c., about half-way between Glasgow and Edinburgh. Coal and ironstone abound, and there are extensive freestone quarries, brick-works, and paper-mills. The Shotts ironworks were established in 1802. Pop. (1901), 15,662.

**SHREVEPORT**, a city of the United States, capital of Caddo county, Louisiana, on the Red River, 40 miles south of Louisville (Kentucky), and 327 miles by rail north-west of New Orleans, with which it has regular steamboat communication. It is situated in a splendid cotton-growing region, and is an important cotton market. Pop. (1890), 11,979.

**SHUJABAD**, a town in Multan District, Punjab, India, about 5 miles from the present left bank of the Chenab, the trade centre for the richest portion of the district. Pop. (1891), 6329.

**SHUSHAN.** See **SUSA**.

**SIALKOT.** See **SEALKOTE**.

**SIBSÁGAR**, chief town of Sibságar District, Assam Province, India, on the navigable Dikhu, 9 miles south of the Brahmaputra. It was once a capital of the Aham dynasty, and some imposing remains attest its former greatness. It is the seat of some river trade, and has exports of cotton, rice, and, above all, of tea. Pop. (1891), 5249.

**SIDGWICK**, **HENRY**, English philosophical writer, was born at Skipton, Yorkshire, on May 31, 1838, his father being head-master of the grammar-school of that town. He was educated at Blackheath and Rugby, and in 1855 he entered Trinity College, Cambridge, where he had a distinguished career. He graduated as senior classic in 1859, and in the same year became fellow and assistant tutor of his college. He took part in the movement for the abolition of tests, and in connection with it he resigned his fellowship in 1869. In 1883 he was elected Knightbridge professor of moral philosophy

in his university, and two years later he again became an ordinary fellow of his college. He died on Aug. 28, 1900. Sidgwick's published works are: *The Ethics of Conformity and Subscription* (1871); *The Methods of Ethics* (1874; now in sixth edition), a work of great importance, in which he attempts to reconcile utilitarianism with intuitionism; *The Principles of Political Economy* (1883), of an eclectic character; *The Scope and Method of Economic Science* (1885), his presidential address to the economic section of the British Association; *Outlines of the History of Ethics* (1886), an extended reprint of his article on Ethics in the *Encyclopædia Britannica*; and *The Elements of Politics* (1891). Sidgwick and his wife, a sister of the Right Hon. A. J. Balfour, took a leading part in the foundation and development of Newnham College and in the opening of university examinations to women. One of his sisters was the wife of Archbishop Benson, his cousin.

**SIDI-BEL-ABBÈS**, a fortified town of Algeria, in the department of Oran, 48 miles by rail south of Oran, on the Mekerra, in a healthy, fertile, and populous plain. It is a town of quite recent origin, and is the centre of one of the chief esparto-grass districts in Algeria. It also carries on a trade in alfa, cattle, hides, &c. Pop. in 1896, 23,288.

**SIDMOUTH**, **VISCOUNT.** See **ADDINGTON**, **HENRY**.

**SIEGFRIED.** See **SIGURD**.

**SI-GAN-FOO.** See **SI-NGAN-FOO**.

**SILCHAR**, a town of India, the chief town of the Cachar district of Assam, and a military cantonment, on a neck of land formed by a bend of the river Barak. The town has suffered on several occasions from earthquake shocks. Pop. (1891), 7523.

**SILURES**, an ancient British tribe which inhabited the district included in the modern counties of Hereford, Radnor, Brecknock, Monmouth, and Glamorgan. They were of the earlier Celtic stock, and were amongst the most warlike of the British tribes. They were subdued by the Romans about 78 A.D. It is very probable that they included a large Iberian or pre-Celtic element.

**SILURUS**, a genus of fishes of the family Siluridae, order Physostomi. See **SHEAT-FISHES**.

**SILVER FIR.** See **FIR**.

**SIMCOE LAKE**, a lake of prov. Ontario, Canada, between Lake Ontario and Georgian Bay, an arm of Lake Huron, about 50 miles north of Toronto. It is about 30 miles long and 18 miles wide, with an area of some 283 square miles, and discharges itself into Lake Huron by the river Severn. Its banks are well wooded, and it contains several islands. On its banks stand the towns of Barrie and Orillia, and the district is now covered with a net-work of railways.

**SIMON**, **JULES** (properly **JULES FRANÇOIS SIMON SUISSE**), a French philosopher and statesman, was born at Lorient, department of Morbihan, on 31st Dec., 1814, and educated first at the college of his native town and afterwards in the *École Normale*, Paris. In 1839 he succeeded Cousin as professor of philosophy in the Sorbonne, but lost this post in 1852 by refusing to take the oath of allegiance to Napoleon III. He was returned to the Constituent Assembly by the department of Côtes-du-Nord in 1848. In 1855-56 he delivered a series of philosophical lectures in several towns of Belgium, and in 1863 he was returned to the Chamber of Deputies for a division of the department of the Seine. He strongly opposed the war with Prussia, and after the revolution of the 4th Sept., 1870, he became a member of the provisional government, and was minister of education under Thiers from 1871 to

1878. In 1875 he was elected to the senate, and at the same time member of the Academy. In 1876 he became leader of the Republicans, and was minister of the interior and premier until 16th May, 1877, when he was dismissed by MacMahon. He was a consistent advocate of free-trade and of liberal principles, and opposed M. Ferry's bill of 1879 for suppressing non-authorized religious bodies. In 1882 he was elected permanent secretary of the Academy of Moral and Political Sciences. He died in Paris on June 8, 1896. He edited various journals, including the *Siècle* and the *Echo Universel*. His chief works include *Histoire de l'École d'Alexandrie* (1844); *Le Devoir* (1854); *La Liberté de Conscience* (1859); *L'Ouvrière* (1861); *L'École* (1864); *Le Travail* (1866); *La Politique Radicale* (1868); *La Peine de Mort* (1869); *Souvenirs du 4 Septembre* (1874); *Le Gouvernement de M. Thiers* (two vols., 1878); *Le Livre du Petit Citoyen* (1880); *Victor Cousin* (1887); *La Femme du XX<sup>e</sup> Siècle* (1891; many editions since); *Quatre Portraits: Lamartine, Le Cardinal Lavigerie, Renan, L'Empereur Guillaume II.* (1896); &c. He also produced excellent editions of the writings of several great French philosophers, including Descartes and Malebranche.

**SIMON'S TOWN**, a port on the west coast of False Bay, Cape Colony, 22½ miles by rail south of Cape Town, and 17 miles north by west of the Cape of Good Hope. It has a large arsenal, dockyards, three naval hospitals, a high-school, and extensive defensive works. The climate is excellent. Pop. 8572.

**SIMS, GEORGE ROBERT**, journalist and dramatic writer, was born in London on Sept. 2, 1847. He was educated at Hanwell College and in Bonn, and in 1874 became a contributor to *Fun*. A few years later he began a series of contributions to the *Referee* under the pen-name of Dagonet, and he also wrote for the *Weekly Dispatch*. His works on the conditions of life in the London slums did a good deal towards directing the attention of the public to the question of the housing of the poor. His most successful dramas are: *The Lights o' London*; *The Romany Rye*; and, in collaboration, *The Harbour Lights*; *In the Ranks*; and *London Day by Day*. His novels include *Rogues and Vagabonds*; *The Ring o' Bells*; *Dorcas Dene, Detective*; &c. He has also written volumes of poems, amongst which are *Dagonet Ditties*; *In the Harbour*; &c.

**SI-NGAN-FOO**, **HSIAN-FOO**, **SE-CHAN-FOO**, a large and ancient city of Northern China, capital of the province of Shense (Shen-si), on the river Wei-ho near its confluence with the King-ho, some distance west of the great bend of the Hoang-ho. It is said to have been the Chinese capital from 1122 B.C. to 1127 A.D., and is rich in antiquities. The city is surrounded by strong walls, and contains an imperial palace and an arsenal. It is a great emporium of trade. The Chinese court retired to this city during the troubled period of 1900-1. The pop. is estimated at from 500,000 to 1,000,000.

**SIOUX CITY**, a flourishing city of the United States, capital of Woodbury county, Iowa, the second city of its state, on the east bank of the Missouri, where it is joined by the Big Sioux River, and at the south-east corner by S. Dakota. It is a well-built town, and has extensive packing-works, very large flax-seed-oil mill, and manufactories of various kinds. It is the centre of a rich agricultural district, and is increasing very rapidly. Among its buildings and institutions are a city-hall and public library; a police building; a county court-house; a Y.M.C.A. building; the university of the north-west; a high-school; a United States government building; hospi-

tals; &c. The Missouri is here crossed by a bridge. Though laid out only in 1854 it had in 1890 a population of 37,893. In 1880 the population was only 7386.

**SIOUX FALLS**, a city of the United States, the capital of Minnehaha county, South Dakota, on the Big Sioux River, 90 miles north of Sioux City, Iowa. It stands in a good agricultural district containing many stone quarries. Jasper is largely used for paving and building. Considerable power is derived from the falls of the river. It is the seat of a Protestant Episcopal bishop and of a Roman Catholic bishop. Pop. (1890), 10,177; (1894), 13,564.

**SIRAJGANJ**, or **SERAJGUNJ**, a town of India, in Pabna district, Bengal, and the most important river mart in the province. It is situated near the main stream of the Brahmaputra, and is a central market for the produce of the surrounding country. Pop. (1891), 23,267; (1901), 23,114.

**SIR-DARIA**, a Russian district of Central Asia, which lies on both sides of the river Jaxartes or Sir-Daria; area, 194,853 square miles; pop. in 1897, 1,479,848. It has Akmolinsk on the north; Aral Sea on the west; Khiva, Bokhara, and Ferghana on the south; and Semiretchensk on the east. It is drained by the Sir-Daria and the Chu, but much of it is desert. It includes the Kara-tau, Ak-sai, and Alexander Mountains, separating the basins of the Jaxartes and the Chu. The population is mixed, including Kirghiz, Tajik, and other stocks. Nearly half the land is devoted to pasture. Among the animals reared are large numbers of camels, sheep, horses, and cattle. The chief town is Tashkend (pop. 156,414).

**SIRHIND**, a tract of land intervening between the Jumna and Sutlej rivers, Punjab, India. The whole tract has hitherto been unfertile from want of irrigation, but the lately-opened Sirhind Canal will doubtless remedy this defect.

**SIRIPUL**, a town in Afghan Turkestan, on a river of the same name, 100 miles s.w. of Balkh. The inhabitants are chiefly Uzbeks. Pop. about 18,000.

**SIROHI**, a native state in the Rajputana Agency, India; area, 1964 square miles. It is bounded on the north by Marwar, east by Mewar, south by Palanpur, &c., and west by Jodhpur. The country is much intersected and broken up by hills and rocky ranges, culminating in Mount Abu, and frequently suffers from drought. Dense forests cover the lower slopes of the Aravalli Mountains. The chief river is the Western Banas, but it is not perennial. Wheat and barley are the staple crops. Pop. (1891), 186,025.—The capital has the same name, and is 170 miles from Ajmere. It has manufactures of sword-blades, daggers, knives, and spears. Pop. (1891), 6372.

**SIRSA**, a former district of the Punjab, India, now divided between the districts of Hissar and Ferozpur. The town of Sirsa, a place of considerable trade, with a large annual cattle fair, is now in Hissar district. Pop. (1891), 16,415.

**SISAL**, or **GRASS HEMP**, a species of agave yielding a valuable fibre, a native of Mexico, Honduras, Central America, and specially cultivated in Yucatan. It is grown upon stony ground, and the leaves, from which the fibre is prepared, are between 2 and 3 feet long. The pulp is cleaned away from each side of the leaf, and the remaining fibre is then washed and sun-dried. It has considerable commercial value in the manufacture of cordage and coarse cloth, on account of its damp-resisting properties.

**SISTAN**. See **SERISTAN**.

**SISTERHOODS**, a name given to various religious and charitable orders or associations of women.

These are very numerous, and have recently increased in number. The oldest and largest is the Sisters of Charity (also called Gray Sisters, Daughters of Charity, Sisters of St. Vincent de Paul), a Roman Catholic order, founded in 1634 at Paris by St. Vincent de Paul, for the work of nursing the sick in hospital and in their homes, and for the performance of charitable offices generally. The sisters take simple vows of poverty, chastity, and obedience, which are annually renewed; they add a fourth vow binding themselves to serve the sick. They number some 30,000 or 40,000, in upwards of 2000 houses, scattered over all parts of the civilized world. The Little Sisters of the Poor form another numerous charitable order, founded in France in 1840. They are numerous in other countries besides France, their special work being the care of poor and aged people of both sexes. Since about the middle of the nineteenth century a number of sisterhoods have been established in connection with the English Church, the members devoting themselves to mission work, hospital work, the reclamation of fallen women, teaching, &c. Some of these have a number of houses in London and elsewhere. In Ireland there are the Sisters of Charity, a congregation founded in Dublin in 1815 by Mary Frances Aikenhead, for the purpose of ministering to the sick and poor in hospitals and at their own homes. The rule is that of the Society of Jesus so far as it is suitable to women. The order has over twenty houses in Ireland. The Sisters of Mercy are another important and flourishing order, founded in Dublin in 1827, for carrying on works of mercy. Other similar associations are the Sisters of the Assumption, founded 1839, educational; Sisters of St. Brigid, or of the Holy Faith, an Irish educational order, founded 1857; Sisters of the Good Shepherd, founded in 1646 for the reformation of fallen women; Sisters of the Holy Child Jesus, a recently-founded American educational order; &c. See MERCY (SISTERS OF) in SUPP.

**SITAPUR**, a district of British India, in the Lucknow division of the province of Oudh, United Provinces; area, 2255 square miles; pop. (1891), 1,075,413. The district consists of a plain, and is generally well wooded and closely cultivated.—**SITAPUR**, the capital of the district, is picturesquely situated on the Sarayan river, 52 miles N. by W. of Lucknow. There are cantonments here. Pop. (with cantonments, 1891), 21,380; (1901), 22,557.

**SKEAT**, **WALTER WILLIAM**, a distinguished English scholar, was born in London on Nov. 21, 1835. He was educated at King's College School and Highgate School, London, and matriculated at Christ's College, Cambridge, where he graduated as fourteenth wrangler in 1858. Two years later he became a fellow of his college and curate of East Dereham, in Norfolk, and in 1862 he went to Godalming, in Surrey, as curate. He was appointed a mathematical lecturer of Christ's College in 1864, and since 1878 he has held the Erlington and Bosworth professorship of Anglo-Saxon in the university. In 1883 he was re-elected to the fellowship which he had vacated by marriage. Dr. Skeat's work in the philology of the English language, especially in its older forms, is of the utmost value, and has contributed much to stimulate interest in such studies. His chief original publications in this department are: *A Mæso-Gothic Glossary* (1868); *Etymological Dictionary of the English Language* (1879-84), his most important work; *Concise Etymological Dictionary of the English Language* (1882; new edition, rewritten and rearranged, 1901); *Principles of English Etymology* (two series, 1887 and 1891); *Primer of English Etymology* (1892), a smaller work based upon the

preceding, but dealing only with the native element; *The Chaucer Canon*, with a *Discussion of the Works associated with the name of Geoffrey Chaucer* (1900); *Place Names of Cambridgeshire* (1901); and *Notes on English Etymology* (1901). Among the numerous editions of English texts which he has edited for various societies and publishers we may mention the following: *Lancelot of the Laik* (E. E. T. S., 1865); *Northumbrian and Old Mercian Gospels*, synoptically arranged, (1858-78; new edition, 1890), the completion of a work begun by J. M. Kemble; *Havelok the Dane* (E. E. T. S., 1868); *Barbour's Bruce* (1870-89); *Specimens of Early English* (new edition, 1879), with Dr. R. Morris; *The Vision of William concerning Piers the Plowman* (two vols., 1886), giving the three texts parallel, with notes, glossary, &c.; *Ælfric's Lives of Saints* (1882-98); *Chatterton's Poems* (1871); *Twelve Facsimiles of Old English Manuscripts* (1892), with introduction, &c.; *The Works of Chaucer* (with notes, glossary, &c., six vols., 1894-95; with a supplementary vol. of spurious Chaucerian pieces, 1897); and *The Student's Chaucer* (1895). He founded the English Dialect Society in 1873, and was its chief member during the twenty-three years of its existence. For it he prepared several provincial glossaries, and upon these and the other publications of the society the new *Dialect Dictionary* is based. A *Student's Pastime* (1896) consists of articles contributed by him to *Notes and Queries*. He has also translated Uhland's *Songs and Ballads* (1864).

**SKEGNESS**, a rising English watering-place on the Lincolnshire coast, 20 miles north-east of Boston; with hotels, lodging-houses, pleasure-gardens, pier, and fine sands. Pop. (1891), 1488; (1901), 2140.

**SKELTON**, a town of England, North Riding of Yorkshire, district of Cleveland, 10 miles east by south of Middlesbrough, with extensive iron-mines. Pop. of urban district of Skelton and Brotton in 1891, 11,842; in 1901, 13,239.

**SKENE**, **WILLIAM FORBES**, Scottish historian and Celtic scholar, was born 7th June, 1809, at Inverie, in Knoydart, Inverness-shire, being the son of James Skene of Rubislaw, an intimate friend of Sir Walter Scott, while his mother was a daughter of Sir W. Forbes of Pitligo. He was educated at the High School, Edinburgh, and studied in Germany and at St. Andrews and Edinburgh Universities. In 1831 he became a writer to the signet, and for about forty years was the head of a prominent legal firm. From an early age he devoted his leisure to archaeological and historical research, being a keen student of national and family history, and familiar with the Highlanders and their language from his youth up. His chief works include *The Highlanders of Scotland, their Origin, History, and Antiquities* (two vols., 1837); *The Four Ancient Books of Wales* (two vols., Edin. 1868); and *Celtic Scotland, a History of Ancient Alban* (three vols., Edin. 1876-80). The last is his chief work, and as a monument of learning, industry, and historical insight, is never likely to be superseded. Its first volume deals with the history and ethnology, the second with the church and culture, and the third with land and people. Besides the above he edited *The Dean of Lismore's Book*, with Introduction and Notes (1861); *Ancient Gaelic Poetry*; *Chronicles of the Picts and Scots*, and other *Early Memorials of Scottish History* (1867); and *Fordun's Chronicles of the Scottish Nation* (two vols., 1871). Another work of his was one on the family of Skene of Skene for the New Spalding Club. He was active in charitable and religious work (he belonged to the Episcopalian body), was well equipped in theology, and, compiled a little manual entitled

Gospel History for the Young. He was LL.D. of Edinburgh and D.C.L. of Oxford, and in 1881 was appointed historiographer royal for Scotland in succession to John Hill Burton. He died at Edinburgh on 29th August, 1892.

SKIEN, a town and seaport of Southern Norway, on the navigable river named from it, 65 miles south-west of Christiania, with which it is connected by railway. It was originally founded in the fourteenth century, but, owing to repeated destructions by fire (the last in 1886), it is of quite modern construction. Its chief buildings are the new church; the fine town-house; and the Festivitets-Lokal, with a public library and baths. Skien is the birthplace of Ibsen. Pop. about 9500.

SLAITHWAITE, a manufacturing village of England, in Yorkshire (W. Riding), on the river Colne, 5 miles south-west of Huddersfield, with factories for cotton-spinning, woollen, and worsted goods; and mineral baths that attract many visitors. Pop. (1891), 4570; (1901), 4763.

SLIEVEN, SLIVEN, or SLIVNO, a town of Eastern Roumelia, at the foot of the Balkans, 70 miles to the north of Adrianople, with manufactures of cloth, otto of roses, &c. The vine is cultivated in the district, and there is an important annual fair. Pop. (1900), 24,542.

SLIVEN. See preceding article.

SLOTH-BEAR. See ASWAIL in SUPP.

SLÖYD, SLOÏD (a Scandinavian word equivalent to the English *slight*), a system of manual training for pupils in elementary and higher schools, much in vogue on the Continent and practised in some English educational establishments, in which the pupils are accustomed to the use of tools in a handicraft which is not necessarily intended to form their future exclusive or main occupation. It is applied to any useful hand-work, such as carpentry, metal-work, basket-work, fretwork, bookbinding, &c., but is usually confined to wood-sloyd, or the use of the knife and carpenter's tools. The advocates of the Sloyd system lay stress on its great educational, rather than on its practical value. They claim for it an important moral, physical, and intellectual influence over the pupil. The work done under it is not intended for teaching trades, nor is it advisable to have skilled artisans as teachers. The conception of such a system is found in the works of certain German philosophers and educationists, but it was in Sweden that it was first introduced. There is a training school for Sloyd near Gothenburg, which is attended by teachers from all countries. The system is already practically introduced into America under the name of *manual training*. A Sloyd association, known as the Educational Hand-work Association, has been formed in Britain.

SMALL HOLDINGS. See ALLOTMENTS in SUPP.

SMILES, SAMUEL, LL.D., was born at Haddington, Scotland, on Dec. 23, 1812, and educated for the medical profession. He practised for some years as a surgeon at Leeds, when he became editor of the Leeds Times in succession to Robert Nicoll. In 1845 he became secretary to the Leeds and Thirsk Railway, and in 1854 to the South-Eastern Railway, from which he retired in 1866. He is the author of many works on industrial enterprise, the chief of which are: *Life of George Stephenson* (1857); *Selp-Help* (1859), which attained a very great success; *Workmen's Earnings, Strikes and Wages* (1861); *Lives of the Engineers* (four vols., 1861; new ed., five vols., 1875); *Industrial Biography* (1863); *Lives of Boulton and Watt* (1865); *The Huguenots, their Settlements, Churches, and*

*Industries in England and Ireland* (1867); *Character* (1871); *The Huguenots in France after the Revocation of the Edict of Nantes* (1874); *Thrift* (1875); *Lives of Thomas Edward* (1876), *Robert Dick* (1878), and *George Moore, Merchant and Philanthropist* (1878); *Self-Effort* (1889); *Jasmin, the Barber-Poet* (1891); and *Josiah Wedgwood* (1894). These works are characterized by their good moral teaching, they are written in a clear and simple style, and many of them have been translated into various European languages. The University of Edinburgh conferred the degree of LL.D. on Smiles in 1878. He has contributed largely to various reviews and other periodicals.

SMITH, GEORGE, writer on Indian subjects, was born at Leith on April, 28 1833. Educated at the High School and University of Edinburgh, he was principal of Doveton College, Calcutta, in 1854-59, and editor of the Calcutta Review in 1857-64. He afterwards edited *The Friend of India* for a long period, and during the fifteen years 1860-75 he was India correspondent of *The Times*. From 1879 till his retirement in 1901 he discharged the duties of foreign secretary to the Free (latterly United Free) Church of Scotland. He is a companion of the order of the Indian Empire, and an honorary LL.D. Dr. Smith has written admirable works on the history of missions and missionaries, especially in India, including a *Short History of Christian Missions* (1884); *The Conversion of India, from Paganism to the Present Time* (1894); *Life of Dr. John Wilson* (1878); *Life of Alexander Duff* (1879); *Life of William Carey, Shoemaker and Missionary* (1885); *Stephen Hislop: Pioneer, Missionary, and Naturalist in Central India* (1888); *A Modern Apostle* (1890), being a life of the Rev. A. N. Somerville; *Henry Martyn, Saint and Scholar* (1892); and *Twelve Pioneer Missionaries* (1899). He also edited the *Annals of Indian Administration* (nineteen vols.), and wrote the following works: *India since the Mutiny* (1874); *The Student's Manual of the Geography of British India, Political and Physical* (1882); and *Twelve Indian Statesmen* (1897).

SMITH, GEORGE, Assyriologist, was born at Chelsea on March 26, 1840, began life as an engraver, but having studied the cuneiform inscriptions of Nineveh, obtained an appointment in the British Museum (1867). A few years later he published the *Annals of Assurbanipal*. In 1872 he made known his striking discovery of a series of tablets in the British Museum containing, amongst other records, the Babylonian legend of the flood. This led to his making two expeditions to the site of Nineveh, resulting in the finding of inscriptions completing portions previously discovered. Particulars of these journeys are recorded in his *Assyrian Discoveries*, published in 1875, and other results were contained in his *Chaldean Account of Genesis* (1876). In 1876 he made another journey to the East for the purpose of continuing his explorations, but died at Aleppo. He wrote, among other works, concise histories of Assyria and Babylon; *The Assyrian Eponym Canon* (1875); and *The Phonetic Values of Cuneiform Characters* (1871).

SMITH, GEORGE ADAM, biblical scholar, son of the above, was born at Calcutta, Oct. 19, 1856. He was educated at the Royal High School and University of Edinburgh, and studied for the ministry in the New College, Edinburgh. After spending a short time at the Universities of Tübingen and Leipzig, he travelled in Egypt and Syria. On his return he became assistant in 1880 in the Free West Church of Brechin; and after two years as Hebrew tutor in the Free Church

College, Aberdeen, he became in 1882 minister of Queen's Cross Free Church in that city. Since 1892 he has been professor of Old Testament language, literature, and theology in the Free (now United Free) Church College, Glasgow. He again travelled in Palestine in 1891 and 1901. Prof. Smith's first publication was a commentary on The Book of Isaiah (two vols., 1888 and 1890), in the Expositor's Bible, which showed both a thorough knowledge of modern criticism and a sympathetic appreciation of the old Hebrew spirit. It was followed by The Preaching of the Old Testament to the Age (1893), and his extremely valuable Historical Geography of the Holy Land (1894; 7th edn., 1901), in which the results of critical inquiry are applied with conspicuous ability in a new direction. His other works include: The Book of the Twelve Prophets (two vols., 1896-97); Life of Henry Drummond (1898); Modern Criticism and the Preaching of the Old Testament (1901), a series of lectures delivered in the United States; and contributions to The Sacred Books of the Old Testament, Encyclopædia Biblica, &c. Prof. Smith has had several honorary degrees conferred upon him. The publication of his Modern Criticism led to the formulation of charges of heretical teaching against him by members of his denomination. These charges were investigated by a committee, which reported to the United Free Church General Assembly of 1902, and by a large majority it was decided to take no action against Prof. Smith.

SMITH, GOLDWIN, writer on historical, political, and other subjects, son of a physician, was born at Reading, Berkshire, on Aug. 13, 1823. He was educated at Eton, and proceeded thence to University College, Oxford, where he had a brilliant career. In 1846 he was elected a fellow of his college and called to the bar at Lincoln's Inn. From 1858 till 1866 he held the regius professorship of modern history at Oxford. He warmly supported the cause of the Union in the American civil war, and on a visit to the United States in 1864 he met with an enthusiastic reception. His writings on this subject include: Does the Bible sanction American Slavery? (1863); On the Morality of the Emancipation Proclamation (1863); and Speeches and Letters on the Rebellion (1865). In 1868 he went to the United States to assume the professorship of English and constitutional history in the Cornell University at Ithaca, but three years later he removed to Canada, where he has since resided. He received the honorary degree of D.C.L. from Oxford in 1882, and is a regular contributor to the British periodical press. In politics he is opposed alike to imperialism and to Irish home rule, and can hardly be said to belong to any party. His publications include: Irish History and Irish Character (1861); Lectures on Modern History delivered at Oxford 1859-61 (1861); Rational Religion (1861); The Empire (1863), a series of letters to the Daily News; Three English Statesmen (1867), dealing with Pym, Cromwell, and Pitt; A Short History of England down to the Reformation (1869); The Political Destiny of Canada (1879); Cowper (1880), in the series of English Men of Letters; Lectures and Essays (1881); False Hopes: or Fallacies, Socialistic or Semi-Socialistic (1883); Jane Austen (1890), in the Great Writers Series; Canada and the Canadian Question (1891), in which he prophesies the inevitable absorption of Canada in the United States; William Lloyd Garrison: a biographical essay (1892); The United States: An Outline of Political History (1893); Essays on Questions of the Day, Political and Social (1894), a series of reprinted articles in which his anti-

Semitic, anti-Celtic, and other dogmatism are clearly shown; Oxford and her Colleges (1895); Guesses at the Riddle of Existence, &c. (1897); and The United Kingdom: a Political History (two vols., 1899). He has a powerful and attractive literary style.

SMITH, JOHN (commonly known as Captain John Smith), one of the founders of the English colony in Virginia, was born at Willoughby in Lincolnshire on January 6, 1580. After many adventures as a soldier of fortune in Europe, Asia, and Africa he joined in the project to colonize Virginia. The first expedition, which left London in 1606, consisted of three ships with a number of colonists, besides sailors. Dissensions broke out before they had reached their destination, and Smith was condemned to be hanged; but he escaped this fate, and became an active member of the colony. He made important geographical discoveries, obtained supplies from the natives, and was finally intrusted with the guidance of the colony. For a time he was a prisoner among the Indians; but the story of Pocahontas connected with this seems to be, like others of Smith's adventures, undeserving of credibility. (See POCAHONTAS.) In 1609 he was obliged to return to England. He subsequently visited the New England coast for the purpose of trade, and was taken prisoner by a French ship. He died in June, 1631. He published A True Relation of the Events connected with the Colonization of Virginia; Map of Virginia, with a Description of the Country; a Description of New England; General History of Virginia; some books on seamanship, &c.

SMITH, WILLIAM HENRY, son of W. H. Smith, bookseller, publisher, and newsagent, Strand, London, was born in London on June 24, 1825. Educated at Tavistock, he became in due course a member of his father's firm. In 1868 he contested Westminster in the Conservative interest for the second time, and was successful. He continued to sit for Westminster till 1885, when, after the Redistribution Bill, he was returned for the Strand, for which division he was member till his death on Oct. 6, 1891. Mr. Smith was a member of the London School Board from 1870 to 1874, and subsequently held the following appointments:—financial secretary to the treasury (1874-77), first lord of the admiralty (1877-80), secretary for war (1885). In 1886, on the resignation of Lord Randolph Churchill, Mr. Smith vacated the war office and assumed the leadership of the House of Commons as first lord of the treasury. His leadership was very successful, and won him the respect of all parties. He received the degree of D.C.L. from Oxford University in 1879. See Sir Herbert Maxwell's Life and Times of the Right Hon. W. H. Smith (1893).

SNAPPING-TURTLE, a species of American fresh-water tortoise belonging to the genus *Chelydra* (*C. serpentina*). See TORTOISE.

SNEEZE-WOOD, a South African tree (*Pteroxylon utile*), with pinnate leaves, natural order Sapindaceæ, yielding a solid, strong, durable timber rivaling mahogany in beauty. Its dust causes sneezing, so that it is troublesome to work.

SNEEZE-WORT (*Achillea ptarmica*) a British composite plant of the milfoil genus, the pulverized leaves of which are said to cause sneezing. Its flower-heads are rather smaller than those of the daisy, and have both ray and disk white.

SNOW-PLOUGH, an implement for clearing away the snow from roads, railways, &c. There are two kinds: one adopted to be hauled by horses, oxen, &c., on a common highway; the other to be placed in front of a locomotive to clear the rails of snow. A variety of the latter is adapted to street

tramways. The former kind usually consists of two boards fitted together so as to form an acute angle in front which is made to enter the snow.

SOANE, SIR JOHN, English architect, was born at Whitchurch, near Reading, on Sept. 10, 1753. He was a mason's son, and was for a time an errand-boy, but having gained some architectural knowledge in two offices, he won first the silver medal (1772) and afterwards the gold medal (1776) of the Royal Academy, the latter for a design of a triumphal arch. With the gold medal went a travelling studentship, which enabled him to spend three years in Italy. On his return he was employed on many public works. In 1788 he was appointed architect to the Bank of England, and in 1791 clerk of works to St. James's Palace, the Parliament Houses, and other public buildings. In 1794 he drew up plans for the improvement of the House of Lords, but though they were accepted James Wyatt was engaged to carry them out. He was elected A.R.A. in 1795 and R.A. in 1802, and became professor of architecture to the Royal Academy in 1806. He was knighted in 1831, and died in London on Jan. 20, 1837, having bequeathed his collection of works of art and £30,000 to the nation. The Soane Museum thus formed is housed at 13 Lincoln's Inn Fields, London, and contains antique sculptures, bronzes, gems, models of ancient buildings, a collection of pictures, &c.

SOCIAL DEMOCRATS, an advanced body of socialists. They originated and are chiefly represented in Germany, where they form a strong political party. The Social Democratic Working Men's Party was established in 1869. In 1875 they formulated a programme, which sets forth that labour is the source of all wealth and all culture, and that the emancipation of labour must be the work of the labouring classes. The party aims at the development of a free state and a socialistic society, the removal of all social and political inequality, &c. Religion is to be regarded as a private concern merely. The social democrats are a growing body in England and America.

SOCIOLOGY, the science which investigates the laws and forces which regulate human society in all its grades, existing and historical, savage and civilized; or the science which treats of the general structure of society, the laws of its development, and the progress of actual civilization. Comte was the first to treat the subject from a scientific point of view. He was followed by Quetelet and Herbert Spencer. Sociological investigation has been profoundly influenced, and indeed almost completely transformed, by the application of evolutionary principles. Society is now regarded as an organism consisting of co-ordinated and mutually-dependent parts, each of which has its own special function or functions; and social development or evolution is regarded as proceeding in accordance with the same laws and on the same method as organic evolution, of which indeed it is but the highest and most complex stage. The older or 'atomic' theory, which regarded the individual members of a society as almost entirely distinct and independent, and the social form as superficial and accidental, has completely disappeared as a reasoned belief, but it still lingers on in various archaisms and inconsistencies of thought and speculation. See Comte's *Traité de Sociologie*; Spencer's *Study of Sociology* (1874), and *Principles of Sociology* (1876-96, 3 vols.); Benjamin Kidd's *Social Evolution* (1894); Henry Drummond's *Ascent of Man* (1894); Schäffle's *Bau und Leben des Socialen Körpers* (2nd edition, 1896); Giddings' *Principles of Sociology* (1896); &c.

SÖDERHAMN, a town of Sweden, in the pro-

vince of Gefleborg, on the west coast of the Gulf of Bothnia, some 43 miles north of Gefle. It carries on an important trade in iron and timber, and has railway communication with Stockholm and the other chief towns of the country. Pop. (1900), 11,258.

SOGNEFJORD, an extensive fjord on the west coast of Norway, exhibiting magnificent rock and glacier scenery. It is in latitude 61° N., in the province of Bergen, and penetrates almost to the borders of the province of Hamar.

SOHAR, an important seaport of south-east Arabia, on the coast of Oman, about 120 miles to the north-west of Muscat. It is a fortified town, with a considerable trade; and amongst its industries are weaving and working in gold and silver. Pop. 24,000.

SOLEMN LEAGUE AND COVENANT. See COVENANT.

SOLENHOFEN, or SOLNHOFEN, a village of Bavaria, near Eichstadt, noted for its lithographic stones. See LITHOGRAPHY.

SOMA, a plant belonging to the natural order Asclepiadaceæ, the *Asclepias acida*; also an intoxicating drink obtained, it is supposed, from the plant, which the ancient Aryans believed was pleasing to the gods as a sacrifice. They went so far in their adoration of soma that they personified it as one of their highest gods.

SOMBRERO ISLAND, a small rocky British island midway between Anguilla and the Virgin group, West Indies. It has a lighthouse, and had large deposits of phosphate of lime, now worked out.

SOMERSET, ROBERT CARR, EARL OF, a favourite of James I., was born in Scotland in 1589, and died in July, 1645. He was at first a page to James, and followed him to England when he succeeded Elizabeth, in 1603. The king became greatly attached to him, made him treasurer of Scotland, and gave him a seat in the upper house with the title of Viscount Rochester, and then Earl of Somerset. In the height of his greatness he married the divorced wife (with whom he had previously had an improper intimacy) of the young Earl of Essex, contrary to the advice of his friend and secretary, Sir Thomas Overbury. The countess never forgave Overbury for this; and on her suggestion he was sent to the Tower for some trivial offence, and after a few months despatched by poison. The murder was discovered, and all the parties to it were condemned. The tools in the crime were executed, but Somerset and his wife were kept in the Tower. After a few years' imprisonment the unhappy pair obtained their freedom and spent the rest of their days in obscurity and disgrace. See OVERBURY; and for a discussion of the whole affair see Mr. R. S. Gardiner's history of the period.

SOMERVILLE, a city of the United States, in Middlesex county, Massachusetts, forming really a suburb of Boston.

SONDERBURG, a town of Prussia, in Schleswig-Holstein, on the island of Alsén, and on Alsén Sound, connected with the mainland by a pontoon bridge. Pop. (1895), 5247.

SONNEBERG, a town of Germany, in the Duchy of Saxe-Meiningen, on the Röthen, about 12 miles east of Coburg. Its chief industry is connected with the manufacture of toys, chiefly dolls, of wood or papier-maché, which go to all parts of the world, but especially to Britain and America. Pop. (1900), 13,317.

SONNENBURG, a town of Prussia, district of Frankfurt, on the Lenze, with silk weaving and other industries. Pop. (1895), 5848.

SORACTE, a celebrated mountain of Italy, 27 miles north of Rome, now called Monte Sant' Oreste;

height, 2420 feet. It had a temple of Apollo on its summit.

**SORATA**, or **ILLAMPU**, one of the highest of the Andes, a volcanic cone in Bolivia, on the east side of Lake Titicaca. If, as Sir Martin Conway has recently estimated, the height of Sorata is 23,500 feet, it is the culminating point of South America.

**SOREL**, a town and river port of Canada, in the province of Quebec, on Lake St. Peter, at the mouth of the river Richelieu, with some manufactures and a considerable trade. It has docks, barracks, an arsenal, a Roman Catholic college, convent, &c. It was formerly the governor-general's summer residence. Pop. (1891), 6669; (1901), 7057.

**SORIA**, a town of north-eastern Spain, capital of the province of that name, on the Douro, 120 miles N.E. of Madrid. It contains an old palace and an old church, besides some interesting remains, but is of no other importance, save as the capital of the poorest province of Spain. Pop. 7784.

**SOROKI**, a town of Russia, in the government of Bessarabia, on the Dniester. The vine is cultivated in the vicinity, and a considerable export trade in corn and tobacco is carried on. Pop. 12,000.

**SÖUL**. See **SEOUL** in SUPP.

**SOUTH AFRICAN WAR (1899-1902)**. It is unnecessary here to attempt to set forth all the causes that brought about the war between Britain and the two Dutch republics of South Africa, if indeed our knowledge is at present sufficiently complete and accurate. The friends of the late republics would probably assert that they were practically forced to enter on the course they did in order to defend their liberties, which were being threatened by Britain or by those who favoured British rule, and that Britain's lust for gold and territory was the real cause of the struggle. To this it might be replied on behalf of Britain, that she had no wish to interfere with the liberties of either state, and repudiated any desire for more territory; that she had a right to demand better treatment for her people in the Transvaal—equal treatment for all being a promise of long standing—but that she had no intention of resorting to hostilities, and no expectation that war would break out, otherwise she would have been better prepared for it; also that she had no quarrel whatever with the Orange Free State, and that the two republics were the aggressors, since they invaded British territory, and proclaimed its annexation. The fact is, that a considerable body of the Dutch population of South Africa have never been reconciled to the rule of the British, and no doubt reasonable grounds for discontent have not been wanting. (See **BOERS**.) The small amount of compensation allotted to the Cape Colony, on the abolition of slavery in 1833, was one cause of much bitterness, and the retrocession of frontier territory to the Caffres was another. The 'Great Trek' begun in 1835 was an exodus of parties of discontented Boers—some 10,000 in all—from the Cape Colony, the movement latterly resulting in the establishment of the Transvaal or South African Republic, and the Orange Free State. The settlement agreed to by Mr. Gladstone's government in 1881 after Majuba—followed in a modified form by that of 1884—was generally looked upon by the Boers of the Transvaal as a triumph for them. 'Majuba day' was annually celebrated as commemorating a great event in their history, and this tended to keep alive a spirit of hostility to Britain, and to foster thoughts of a greater triumph that might be attained in the future. The wars with the natives, continued even after 1884, had made the Boers on the whole a military people, and about 1893 Pre-

sident Kruger began to increase the Transvaal armaments, seeing that nothing but force could ultimately keep the Outlanders—that is, the non-Boer settlers in the Transvaal, especially in Johannesburg—from gaining political rights, and that force would also be necessary to enable him to get rid entirely of British supremacy, and to secure, what he had long desired, free access to the coast. The Jameson Raid, so called—an ill-advised attempt made at the close of 1895 by a handful of British subjects, who invaded the Transvaal with a view to gaining some advantage for the Outlanders—furnished an excellent pretext for increasing the warlike equipments of the country, and the gold mines of the Rand supplied the funds which were lavishly spent on rifles, artillery, ammunition, &c., all of the newest and best. These funds had to be provided by the Outlanders, who, though they bore the great bulk of the taxation, and owned a great share of the property in the Transvaal, were excluded from any share in the government, and were treated in a harsh and domineering spirit. Early in 1899 a numerously-signed petition from British residents in the Transvaal was forwarded by Sir Alfred Milner, the high commissioner, to the home government, setting forth the grievances of the petitioners, and declaring their position to have become 'intolerable'. It was then arranged, on the invitation of President Steyn of the Orange Free State, that matters should be discussed between the high commissioner and Mr. Kruger at the Free State capital, Bloemfontein. The parties held meetings from 31st May to 5th June, but no agreement was arrived at. Mr. Kruger now submitted to the Transvaal Volksraad a franchise scheme of his own, professedly meeting all legitimate or reasonable claims of the Outlanders. To this many of his friends gave their approval, though Sir A. Milner thought it came far short of what was required. Then followed more negotiations, which sometimes seemed to give hope of a satisfactory result; but, apart from the franchise question, the inadmissible claim of the South African Republic to the status of a perfectly-independent state still barred the way to a settlement. Meantime the war spirit was rising in the Transvaal; loyalists in South Africa, and especially in Natal, began to get uneasy, and urged upon the home government the necessity of taking steps for their defence in view of a possible outbreak of hostilities. On Sept. 8 the British cabinet decided to raise the garrison in South Africa to a strength sufficient to protect the colonies, while still continuing their efforts for peace, and it was deemed that an addition of 10,000 men, to be drawn from India and the Mediterranean, would be quite sufficient for the purpose. Latterly, as a reply to the offer of the British government (on 22nd Sept.) to formulate their own proposals for a final settlement of the issues which had been created by the policy long followed by the government of the South African Republic, the latter presented an ultimatum which could only mean war. In this document, delivered to the British agent in the Transvaal on Oct. 9, for answer within forty-eight hours, it was demanded that all matters in dispute should be settled by arbitration or in some other way to be agreed on; that all troops on the borders of the republic should be instantly withdrawn; that reinforcements which had arrived in South Africa since 1st June should be removed from South Africa within a reasonable time; and that the troops now on their way to South Africa should not be landed. This, of course, as was intended, was equivalent to a declaration of war, and war at once followed, the Orange Free State, by a previous arrangement,

joining the neighbouring republic, apparently with anything but reluctance on the part of President Steyn and a large proportion of the people. According to the author of *The Times History of the War in South Africa*: 'The Transvaal went to war sooner than concede a small instalment of reform, and had no sooner declared war than it openly avowed that the object of that war was—not the maintenance of the Transvaal franchise in its existing form, but the destruction of the British power in South Africa. It was not merely in its strategy, but in its whole political objects, that the war begun by the Transvaal was a war of aggression. In the eyes of militant Afrikanerdom it was not a war fought about some specific dispute; it was the war—the great war against the national enemy to which they had steadily looked forward.'

The war was actually begun by the Boers invading Natal and Cape Colony, Ladysmith in the former and Kimberley and Mafeking in the latter being the places in which the greatest interest was almost immediately centred. At the beginning of the struggle the British regular troops in South Africa did not greatly exceed 20,000 in number, about half of them being in Natal under the command of Sir George White, who had his head-quarters at Ladysmith. On Oct. 20th the Boers who had invaded northern Natal endeavoured to cut off the British camp near Dundee, where General Symons was stationed with about 5000 men. They were repulsed at Talana Hill, but the British general was mortally wounded; and the following day they were more severely defeated at Elandslaagte by General French's force from Ladysmith. It was necessary, however, to withdraw the northern garrison to Ladysmith, and this was done—after the Boers had been beaten off by General White at Rietfontein. The enemy were now in such force that (with Joubert as commander-in-chief) Ladysmith was soon completely invested, the railway from the south being seized, as well as the bridge over the Tugela at Colenso. Fortunately several naval guns had been got into Ladysmith before this, which enabled its defenders to reply to the powerful artillery that the Boers had planted on the neighbouring heights. Swarming down into Natal the invaders overran the country as far as the Mooi River and beyond, and it appeared that they might even attack Maritzburg; but the first army corps of 54,000 men reached South Africa in November, and General Sir Redvers Buller, who had arrived to take supreme command, took under his charge a large portion of this force, and so was able to drive the Boers back and prepare for the relief of Ladysmith. Other divisions of the reinforcements were despatched inland from Cape Town, Port Elizabeth, and East London to aid in checking the Boer advance into Cape Colony, and to open the way to Kimberley. The force which undertook the latter task was under the command of Lord Methuen, while General Gatacre was to operate against the Boers in the Stormberg district of the Cape Colony, General French being in command of a British force between the two. Advancing northward, Methuen assumed the offensive, drove the Boers from a strong position at Belmont, defeated them two days after at Enslin, and on November 28 dislodged them from a strong position at the Modder River, which was crossed without opposition. Then followed a series of reverses to the British troops, which cast a gloom over the whole empire, and gained for a week in the first half of December the ill-omened designation of the 'black week'.

On Dec. 10 General Gatacre attempted a night attack on a body of Boers strongly posted near

Stormberg, but after a toilsome night march his men unexpectedly came upon the enemy's position, which they were unable to capture, and were driven back with heavy loss. On the same day General Methuen had shelled the Boers previously to attacking their position at Magersfontein. Early next morning, while marching to the attack in quarter column, and on the point of deploying, the Highland Brigade exposed itself to a close fire from the Boer trenches and lost very heavily, the commanding-officer, General Wauchope, being killed. The third and most serious reverse took place in Natal. On the 15th December General Buller attempted, by what has been generally regarded as an ill-judged plan, to force his way across the Tugela at Colenso, with the view of relieving Ladysmith. Notwithstanding a display of admirable courage on the side of the British, and certain partial successes—as was natural with the co-operation of such commanders as Hildyard, Dundonald, and others—the plan as a whole entirely failed, the failure being aggravated by casualties in killed, wounded, and missing amounting to over eleven hundred, while ten splendid guns were abandoned to the enemy.

On receiving the news of General Buller's repulse, the cabinet decided to send out immediately the seventh army division already being mobilized, to call up the remainder of the army reserve, to incorporate a new yeomanry force, to allow twelve battalions of militia to volunteer for service abroad, to employ volunteers on active service, and to accept offers of help made by the great colonies. Lord Roberts was instructed to proceed to South Africa as commander-in-chief, with Lord Kitchener as chief of his staff; and Colonel Hector Macdonald was appointed to succeed General Wauchope in command of the Highland Brigade.

When the year 1900 opened, the troops hemmed in at Ladysmith, Kimberley, and Mafeking were holding their own, but at the first place enteric fever had begun to make serious ravages, and to cause much anxiety. In the Cape Colony General Methuen was confronted by General Cronje in a strongly-intrenched position; and General Gatacre, after falling back from Stormberg, was holding Sterkstroom. General French in the Colesberg district was more actively employed, and succeeded in defeating the Boers in several important actions. Lord Roberts and his staff arrived at Cape Town on Jan. 10, but before anything could be done by the new commander-in-chief, General Buller made another attempt against the Boer position at Colenso (11th January). With this unsuccessful movement is associated the name of Spion Kop, an eminence in the scene of action the seizure and temporary occupation of which cost many British lives to no purpose. Yet a third attempt was made to break through to Ladysmith (on Feb. 5), Vaal Krantz being a position which figured most prominently on this occasion; but again the result was only disappointment, to the besieged force more especially. Meanwhile Lord Roberts had been making plans for more effectively dealing with the enemy, and had got together a strong cavalry force under General French between the Orange River and the Modder. While the attention of the Boers under General Cronje was drawn off by a movement carried out by General Macdonald and the Highland Brigade, General French advanced rapidly on Kimberley, and, in spite of all opposition, reached the place, dispersed the investing troops, and entered the town (16th Feb.). General Cronje at Magersfontein had now allowed himself to get into a difficult position, not fully realizing the strength and intentions of the British, and though he tried to escape eastwards

## LEADERS IN THE SOUTH AFRICAN WAR.



Lord Roberts.



Lord Kitchener.



Sir Redvers Buller.



Sir George Verrill.



General Baden-Powell.



General French.



General Hector Macdonald.



General Sir A. Hunter.



Lord Methuen.

\*.\* The portraits are from photographs by Messrs. Bassano (Lord Kitchener and General Hunter); Elliott & Fry (General Baden-Powell); C. Knight (Sir Redvers Buller); Lafayette, Ltd. (General Macdonald); Lambert, Weston, & Son (General French); Messrs. White, Russell & Sons (Lord Roberts); Window & Grove (Lord Methuen).



towards Bloemfontein, it was too late. He was brought to a halt at Paardeberg, took refuge in the bed of the Modder, where he managed to hold out for a week, but being completely hemmed in, and an attempt at his rescue by De Wet being defeated, he surrendered to General Roberts with over 4000 men. This was on the 27th of February, the anniversary of Majuba. Cronje and the rest of the prisoners were sent to St. Helena. Meanwhile fresh efforts were being made by Buller for the relief of Ladysmith, and this time with success. After a series of difficult operations, the Boer left was finally turned, and on February 28 Lord Dundonald rode into Ladysmith, being followed by General Buller two days later. The garrison was found to be in sore straits for want of food, and had suffered severely from disease as well as from the attacks by which they had been harassed. One of the fiercest of these had been made on January 6, when the Boers had endeavoured to take the town by storm, but were repulsed with heavy loss. On this occasion a position known as Wagon Hill had been three times captured and re-captured in the course of the day, Colonel Ian Hamilton here greatly distinguishing himself. It has been said that 'the successful defence of Ladysmith was from a military point of view the most valuable achievement of the war, inasmuch as the loss of a garrison of 12,000 men would have been a graver disaster than any conceivable defeat in the open field; and, moreover, the fall of Ladysmith was to be the signal for the general rising of the Dutch in the Cape Colony and Natal'. Following on the successes in the west of the Orange State came successful operations by the generals in the northern parts of the Cape Colony—Gatacre, Clements, and Brabant. Bloemfontein now became General Roberts's objective, and after General Joubert had vainly attempted to bar his way at Poplar Grove, and again at Driefontein, the British commander entered the capital of the Orange Free State practically without opposition (March 13). Kruger and Steyn fled away to the north. The keys of the town were surrendered to Lord Roberts, and the railways being soon repaired, through communication was opened between Bloemfontein and Cape Town. The Orange Free State was proclaimed British territory.

There was a long halt at Bloemfontein for various reasons—such as the necessity of getting fresh horses for the mounted troops, and of providing sufficient supplies for a farther advance—but during this period enteric fever proved a terrible scourge, and the enemy were encouraged to fresh activity. Several mishaps now befell different bodies of British troops, and De Wet approved himself a leader of exceptional ability on the Boer side, while Louis Botha also gained distinction for himself, having succeeded to the chief command on the death of Joubert (March 27). The advance northwards from Bloemfontein began on May 3. The British forces under Generals Ian Hamilton, French, and Pole-Carew, with Lord Roberts at their head, often showed a front of 40 miles, and though the enemy repeatedly seemed to threaten a determined stand, no effective resistance was encountered, either on the Vaal or elsewhere. One after another the Boer positions were turned; Botha's troops fled in confusion from Johannesburg, where the British flag was hoisted on May 31, and Pretoria, the Transvaal capital, was occupied on June 5, no attempt being made by the Boers to hold the forts. General Botha and a considerable body of men retired eastwards along the railway in the direction of Komati Poort, near the Portuguese frontier, in which direction President Kruger, Mr. Reitz, and other members of the Transvaal govern-

ment had preceded him. The Boers were followed and beaten at Piensaarspoort, about 15 miles from Pretoria. Meanwhile General Buller had been advancing northwards through Natal, and had entered the Transvaal from that side, driving the Boers before him. On May 15 Dundee and Glencoe were retaken, on the 17th Newcastle, and by the end of the month he was encamped within striking distance of Majuba and Laing's Nek, which were strongly held by the enemy. But by a skilful turning movement General Hildyard secured command of the Boer positions, which were at once evacuated. Buller's force had marched 50 miles in six days, and had defeated the enemy in four engagements. His troops were thus put in a position to co-operate with the main army under Lord Roberts, and early in July the railway all the way to Pretoria from Durban was open. The total number of British troops in South Africa by the middle of the year amounted to about 250,000.

Shortly after the middle of May (1900) a most welcome piece of news reached Britain, namely, that the Boers had been driven from Mafeking, and that the town had been entered by a British force from the south. The place had been invested from the 15th of October, when Cronje with a force of some 9000 men had marched to the attack. Fortunately it was well supplied with stores, and this, but much more the indomitable energy and fertility of resource shown by Colonel Baden-Powell, who commanded the small garrison, enabled it to hold out against all attempts of the enemy to capture it. A last attempt had been made to take the town on May 13 by Commandant Eloff, a grandson of President Kruger. This, like others, not only failed, but the leader and a number of his men were themselves taken prisoners.

In the end of July an important success was gained in the Orange River Colony by General Hunter, with the aid of Generals Rundle, Clement, Bruce-Hamilton, Paget, and Macdonald. As the result of a combined movement, a force of some 4000 Boers under Prinsloo was surrounded by the British troops, and forced to surrender with guns, horses, and wagons, the burghers being sent as prisoners to Ceylon. It had been hoped that De Wet would also be captured, but he, with 2000 men, succeeded in escaping, as on various subsequent occasions.

Advancing eastwards from the Pretoria district Lord Roberts joined hands with Buller, and from his head-quarters at Belfast issued a proclamation annexing the Transvaal to the British dominions (Sept. 1). Previous to this General Buller had forced the Boers from a strong position they had taken up near Machadodorp, and had thus effected the release of a large number of prisoners whom they had taken with them from Pretoria.

On Sept. 11 Mr. Kruger took refuge in Portuguese territory, and many of his compatriots followed his example, or scattered in different directions, having previously destroyed many of their guns, with vast quantities of ammunition and stores. Lord Roberts reported that there was nothing left of the Boer armies but a few marauding bands, but this view of the state of matters proved to be rather premature. On October 6 General Buller left the army for England; on the 20th of the same month President Kruger slipped away to Europe on board a Dutch man-of-war. Lord Roberts left for home before the end of the year, handing over the chief command to Lord Kitchener.

The war had now entered upon what might be called the guerrilla stage, during which the activity and daring of such leaders on the Boer side as Botha and De Wet gave plenty of hard work to the British

troops. Looking with confidence for support from their kinsmen in the Cape Colony and Natal, and still hoping for the intervention of some European power, the Boer leaders planned two enterprises which they thought might yet retrieve their cause. Botha, with some 6000 men, was to make a sudden dash into Natal, and raid the country, if possible, all the way down to Durban, while De Wet was to execute a similar movement in the direction of Cape Town. These attempts were made in the early part of 1901. Botha's plan was completely frustrated by a great sweeping movement of General French; the Boers were dispersed with the loss of guns, wagons, and immense numbers of cattle and sheep. De Wet fared no better, but, like Botha, he himself escaped capture, though losing guns, ammunition, and wagons. Marauding bands that had belonged to his force managed, however, to enter the Cape Colony, and for a time gave much trouble, aided and encouraged as they were by their Dutch friends. To checkmate the Boer system of warfare Kitchener resolved to clear the country of food and cattle so as to deprive the enemy of supplies, to protect the railways by chains of blockhouses, to carry similar chains across the country in suitable directions, and to keep the Boers perpetually on the move by mobile columns of British troops. Lord Kitchener's measures were found exceedingly effective in the long run, but they entailed the gathering together of great multitudes of Boer women and children into the so-called 'concentration camps', where they were fed and cared for while their own people were fighting against the British. There can be no doubt that this humane measure helped to prolong the war, as the burghers were no longer hampered by having to see to the support of those before dependent upon them.

Without attempting to detail the remaining events of the long-drawn-out war, we may briefly state some of the more important. A discussion regarding terms of peace took place between Lord Kitchener and General Botha on March 28, 1901, but nothing came of it; after this the gradual wearing down of the Boer resistance went on, and by the end of May the enemy had lost practically all their artillery (apart from guns buried in the earth). On July 12 the Free State 'government' and some important papers were captured at Reitz. President Steyn himself made a very narrow escape. On Aug. 7 Lord Kitchener issued a proclamation calling for the surrender of the Boers by Sept. 15, on pain of the perpetual banishment of the leaders, and of the property of the others being charged with the cost of maintenance of their families in British hands. What effect this step had is not very clear, but though the Transvaal and Free State leaders had already been discussing the advisability of giving in, President Kruger, from his safe retreat in Europe, urged them to continue fighting till their independence was secured. Renewed activity on the part of Botha, De Wet, and other Boer leaders followed, and the British met with one or two rather serious mishaps. But this could only postpone the already-assured result. By the end of the year 1901 there had been put out of action some 53,000 Boers in all, of whom over 40,000 were in concentration camps, or were kept in custody in St. Helena, Ceylon, India, Bermuda, or elsewhere. After some great 'drives' organized by Lord Kitchener and carried out in the early part of 1902, which resulted in the surrender of many burghers, and which owed their success largely to the blockhouse system, negotiations for peace were at last entered on (March 23), though military operations were not suspended. The Boer leaders were granted facilities for meeting and discussing matters among themselves and with the different com-

mandoes, and after this had gone on for some time, on May 15 a conference of Boer representatives met at Vereeniging to consider terms of surrender. It was not till the last day of the month, however, that peace was absolutely secured, the surrender being signed at Pretoria by Lords Kitchener and Milner and the chief civil and military representatives of the Boers, and the war thus brought to an end. The main points agreed upon were: that the Boer forces would immediately lay down their arms and hand over all guns, rifles, and munitions of war; that burghers in the field outside the Transvaal and Orange River Colony, and all prisoners of war outside South Africa, on declaring their acceptance of the position of subjects of Edward VII., should be brought back to their homes as soon as transport could be provided and their means of subsistence secured; that no proceedings civil or criminal should be taken against burghers so surrendering or returning, for acts done in connection with the war, unless as regards acts contrary to the usages of war; the Dutch language to be taught in public schools where parents desire it, and to be allowed in courts of law; the possession of rifles to be allowed to persons requiring them for protection, on taking out a license; military administration to be succeeded as soon as possible by civil administration, and ultimately representative institutions and self-government; a sum of £3,000,000 to be granted for the purpose of assisting in the restoration of the people to their homes, besides advances on loan free of interest for two years. Rebels belonging to the Cape Colony and Natal were left to be dealt with according to the laws of the respective countries.

In this great struggle there had been engaged on the British side at one time or another, or sent to the seat of war as reinforcements, from the outbreak of war until the conclusion of peace, a grand total of 448,435 men of all arms. In this figure were included 228,171 regulars, 45,566 militia, 35,520 yeomanry, 19,856 volunteers, 7273 South African constabulary, 18,229 regular troops from India, 29,000 Colonial contingents, 52,414 raised in South Africa. Of these 518 officers and 5255 men were killed, 1851 officers and 20,978 men were wounded, 554 officers and 15,617 men died of wounds or disease. How many men the Boers had in the field from first to last, including the rebels belonging to Cape Colony and Natal, will probably never be known. The writer of *The Times History of the War* estimates the number at 60,000 to 65,000. With regard to the relatively large number of British troops he makes the following remarks: 'When all the necessary deductions are made for lines of communication, troops for transport, remount, and supply services, and for the countless other subsidiary duties for which men have to be detailed, it is surprising how few, relatively, remain over to put into the line of battle. But the figures just given for the Boers are net totals. Forty thousand Boers meant practically 40,000 rifles for the firing line. When we further consider that on the South African veld a mounted man is worth fully three or four on foot, not only from the point of view of actual fighting, but also from that of securing supplies and living off the country, the wonder at the nominal disparity of numbers ceases, and gives place to a sense of admiration for the organizing power, for the discipline, and for the adaptability by which so formidable an opponent was overcome.' See *The Times History of the War in South Africa*, by L. S. Amery (vol. i. 1900, vol. ii. 1902—not yet completed); *Cunliffe's History of the Boer War; The Great Boer War*, by Sir A. Conan Doyle; &c.

**SOUTHALL**, a market town of England, in Middlesex, 12 miles west of St. Paul's, forming an urban district with Norwood, a short distance to the south. Pop. (1891), 7896; (1901), 13,200.

**SOUTH BEND**, a city of the United States, capital of St. Joseph county, Indiana, on the St. Joseph River, and on several railways, 85 miles east of Chicago. It has manufactures of wagons, agricultural implements, sewing-machines, &c. Near it is Notre Dame University, an important Roman Catholic institution. Pop. (1890), 21,819.

**SOUTHBOROUGH**, a town of England, in Kent, 3 miles north of Tunbridge Wells, with chalybeate springs in the neighbourhood. Pop. (1891), 5409; (1901), 6977.

**SOUTHERN CROSS**, a constellation of the southern hemisphere, composed of four stars, one of which is of the first, and two of the second magnitude. They form a figure not unlike a cross, especially when seen above the pole, and are the best-known of the southern constellations.

**SOUTHGATE**, an urban district and residential town of England, 8 miles north of London, north of Hornsey, in Edmonton parish. Pop. (1891), 10,970; (1901), 14,993.

**SOUTH GEORGIA**, a barren snow-covered island in the South Atlantic, 500 miles E.S.E. of the Falkland Islands, to which it is regarded as belonging. The area is about 1000 square miles.

**SOUTH KENSINGTON MUSEUM**. See SCIENCE AND ART EDUCATION.

**SOUTH SHETLANDS**, a group of islands in the Southern Ocean, south of S. America, on the Antarctic circle, originally discovered by a Dutch seaman named Dirk Cherrits in 1599. The islands are uninhabited, and covered with snow the greater part of the year.

**SOUTH SHIELDS**. See SHIELDS.

**SOUTHWARK**, a parliamentary and a municipal borough of London, on the south side of the Thames, locally in Surrey. The parliamentary borough includes the three one-member divisions of Rotherhithe, Bermondsey, and West Southwark; the municipal borough comprises West Southwark and a part of Bermondsey, together with the parliamentary borough of Newington (Waltham and West Newington divisions), the remainder of Bermondsey being united with Rotherhithe to form the Bermondsey municipal borough. The most noteworthy church is St. Saviour's (restored in 1890-97), the church of the suffragan bishop of Southwark, containing the tombs of Gower, Massinger, and other famous men. The Surrey commercial docks and Southwark Park are in Rotherhithe, and the Metropolitan Tabernacle is in Newington. The Tabard Inn of the Canterbury Tales and the Globe Theatre of Elizabethan times were in Southwark. Pop. of par. bor. in 1901, 214,085; of metropolitan borough, 206,128.

**SOUTH-WEST AFRICA, GERMAN** (in German, *Deutsch-Südwestafrika*), a colonial possession of Germany in South Africa, bounded on the west by the Atlantic; on the north by Portuguese West Africa, from which it is separated in part by the river Cunene; on the south by Cape Colony, the boundary being the Orange River; and on the east by Bechuanaland. The coast-line is about 930 miles in length, and the colony includes a narrow tongue of land in the north-east extending to the river Zambesi. A small district around Walfish Bay and some islands near the coast belong to Cape Colony. The total area of the territory is about 320,750 square miles, and it is usually regarded as consisting of a northern part, Damaraland, and a southern part, Great Nama or Namaqua Land. Along the coast,

which is generally of a dreary, desert character, there are many sand dunes of considerable size. Inland, the country rises in a terrace formation to a plateau or ridge crossed by mountain chains, from 100 to 200 miles from the coast, the highest elevation being Omatako (8790), north-east of Walfish Bay. To the east of these mountains the territory slopes generally eastwards and southwards towards the Kalahari Desert. None of the rivers flowing to the Atlantic is perennial. The Swakop, reaching the sea at Swakopmund, on the northern frontier of the British enclave, is of some importance, but the longest river in the colony is the perennial Great Fish River, which flows southward and joins the Orange. There are hot springs at Windhoek and elsewhere. The most important harbours are those of Walfish Bay and Swakopmund, the latter of which has recently been much improved by the German authorities, and is now the chief one of the colony. Angra Pequena in the south is an excellent harbour of considerable size, but the country behind it is a waterless desert. The colony is crossed by the Tropic of Capricorn, but the temperature is generally much lower than the latitude would lead one to expect. The rainy season extends from December to May. The rainfall increases from south to north and from west to east. Thus, at Swakopmund in a recent year the total fall was 5 inch, whilst at Windhoek it was 20.3 inches. Except in a few parts the climate is healthy, but much of the country appears to be unsuited for settlement. The fauna is that of South Africa generally. The country to the east of the hills is well adapted for the rearing of cattle and sheep, the former especially in Damaraland, and the latter in Great Namaland. Some districts in the north-east are said to possess good agricultural capabilities, but as a whole the country is not an agricultural one. Copper ore is abundant, and profitably worked in several places. Lead has also been found, and guano deposits on the coast are productive. The native population is generally Bantu in the north, Hottentot in the south, and mixed in the centre. The chief groups are: (1) the Ovambo or Ovampo, north of lat. 19° S., a Bantu people numbering some 50,000; (2) the Herero or Damara, a Bantu people between 19° and 22° S. lat., numbering about 97,000; (3) the Hottentots, south of 22° S. lat., about 13,000 in number; (4) the Hill Damara, a Bushman tribe among the Herero, numbering some 10,000; (5) the Bastards, about 2000, Dutch-Hottentot half-breeds; besides Bechuanaas, Bushmen, &c. The total population in 1901 was about 200,000, including 3639 settled whites. Of the latter, 2222 were Germans and 575 were Boers. The chief exports are guano, cattle, and ostrich feathers, the total value being about £70,000. The imports in 1899 amounted to £447,050. Ox wagons are as yet the leading means of transport. A narrow-gauge railway from Swakopmund to Windhoek was completed in 1902. A German line of steamships regularly calls at Swakopmund and Angra Pequena on the way to Port Nolloth and Cape Town. Several companies, German and English, are exploiting the country. It is under an imperial governor, and for administration purposes it is divided into districts. Germany owes this colony to the business operations of a Bremen merchant, F. A. C. Lüderitz, at Angra Pequena in 1883. Lüderitz acquired rights over a large hinterland, and in 1884 the whole was declared a protectorate of the German Empire, but it was not till 1889 that the Germans could be said to have established anything like an effective authority. Several native rebellions have since had to be suppressed.

**SOUTHWOLD**, a municipal borough, seaport.

and watering-place of England, in Suffolk, near the mouth of the Blyth, 10 miles south by west of Lowestoft, and about the same distance north by east of Aldeburgh. It is pleasantly situated on rising ground, and is a place of various attractions, including fine promenades along the cliffs, and an extensive common. Two naval battles between the English and Dutch are known by the name of Southwold Bay or Sole Bay: the first took place in 1665, the second in 1672, and in both the English, under the Duke of York (James II.), were victorious. Pop. (1891), 2311; (1901), 2800.

SOUVESTRE, ÉMILE, a popular French novelist and dramatist, was born at Morlaix, Finistère, on April 15, 1806. After editing a liberal paper at Brest for some time he settled in Paris (1836), where he attracted attention by his sketches of Brittany, and was soon recognized as one of the foremost writers of the day. Amongst his best works are: *Les Derniers Bretons*; *Foyer Breton*; *L'Homme et l'Argent*; *Confessions d'une Ouvrière*; *Un Philosophe sous les Toits*. The last-named received the prize from the French Academy in 1851. Of his dramas the most noteworthy are *Henri Hamelin*; *L'Oncle Baptiste*; and *La Mousse*. Souvestre is noted for the high moral tone of his writings, and for his sympathy with the poor. He died on July 5, 1854.

SOWERBY, a town of England, in the West Riding of Yorkshire, about 4 miles s.w. of Halifax. It gives name to a parliamentary division. Pop. (1891), 4051; (1901), 3658.

SPAR, in mineralogy, a term employed to include a great number of crystallized, earthy, and some metallic substances, which easily break into rhomboidal, cubical, or laminated fragments with polished surfaces, but without regard to the ingredients of which they are composed. Thus we have the feldspars, fluor-spar, &c.

SPEARMINT (*Mentha viridis*), a European and North American species of mint often cultivated for making sauce and in order to obtain a flavouring essence from it. See MINT.

SPEARWORT, the name popularly given to two entire-leaved species of the genus *Ranunculus*. The great spearwort is the *R. Lingua*, and the lesser spearwort is the *R. flammula*. Both are British plants, with lanceolate leaves and yellow flowers, growing in wet localities. Their undivided leaves readily distinguish them from the common buttercups, which belong to the same genus.

SPEDDING, JAMES, editor of the works of Francis Bacon, was born near Bassenthwaite, in Cumberland, on June 26, 1808, and died from the effects of a cab accident, 1881. He was educated at Bury St. Edmunds and Trinity College, Cambridge, graduated in 1831, and was long an honorary fellow of his college. From 1835 till 1841 he was employed in the Colonial Office. In 1842 he was secretary to Lord Ashburton's mission to the United States, and on the formation of the civil service commission in 1855 he became its secretary. In 1847 he undertook, with the collaboration of Mr. R. L. Ellis and Mr. D. D. Heath, to prepare a complete edition of Bacon's works; but the former died while the task was unfinished, and the latter only gave occasional assistance. The work, therefore, was almost entirely left to Spedding, who completed and published his labours in seven volumes (1857-59). This done, he published *The Life and Letters of Bacon* (seven vols., 1861-74); *Reviews and Discussions*, Literary, Political, and Philosophical, not relating to Bacon (1879); *Evenings with a Reviewer*; *Macaulay and Bacon*; and *Studies in English History* (along with J. Gairdner, 1881).

SPEEDWELL, the common name of plants of the genus *Veronica*, belonging to the natural order Scrophulariaceae, natives of temperate climates all over the world. The species consist of herbs, undershrubs, or shrubs, with opposite or verticillate leaves. The flowers are of a blue, white, or red colour, having two stamens, and a short-limbed, four-cleft, rotate corolla with the segments unequal, and are arranged in axillary or terminal spikes or racemes. The number of British species, which are all herbaceous, is considerable. *V. officinalis*, or common speedwell, was once extensively used as a substitute for tea, and also as a tonic and diuretic. *V. Teucrium*, or germander-leaved speedwell, has much the same properties as common speedwell, and *V. Chamædrys*, or germander speedwell, is a very general favourite, on account of its being among the very first that opens its flowers in the early spring. One of the loveliest forms is the rare *V. spicata*; and amongst other British species are *V. Beccabunga*, or brooklime; *V. Buxbaumii* or Buxbaum's speedwell; *V. Anagallis*, and *V. serpyllifolia*.

SPEKE, JOHN HANNING, African explorer, was born near Ilchester, Somersetshire, May 4, 1827. In 1844 he obtained a commission in the 46th Regiment of Bengal Native Infantry, and took part in the Sikh war. During his leave of absence he made hunting and exploring expeditions over the Himalayas and through parts of Tibet, and collected a great number of specimens of animals, plants, and minerals. In 1854 he accompanied Burton's party in their expedition to Somali Land, and was seriously wounded in that disastrous affair. He next served in the Crimean war, and at its close was invited by Burton to join him in an African expedition, to be carried out at the expense of the home and Indian governments. In June, 1857, Speke and Burton proceeded inland from the east coast, their object being to ascertain the position of the great lakes of the interior, confused accounts of which had been from time to time received from the natives. The great lake Tanganyika was discovered, and Burton falling sick, Speke proceeded north and discovered the south end of the Victoria Nyanza, which he correctly judged to give birth to the Nile. In 1860 he led another expedition, organized by the Royal Geographical Society and supported by the British government. Accompanied by Captain Grant he explored the western and northern margin of the Victoria lake, and found a river flowing out of the lake, which turned out to be the White Nile. After long delays in Uganda and Unyoro the travellers were allowed to proceed northwards, and at Gondokoro they met Sir Samuel Baker, who was leading an expedition southward. Numerous honours, British and foreign, were now accorded Speke, but he did not live long to enjoy them. He was killed by the accidental discharge of his gun while out shooting in the neighbourhood of Bath, Sept. 18, 1864. His discoveries and adventures were described by him in his *Journal of the Discovery of the Source of the Nile* (1863), and *What Led to the Discovery of the Source of the Nile* (1864).

SPELT (*Triticum spelta*), an inferior kind of wheat, grown in various parts of Europe, and known also as German wheat. See WHEAT.

SPENCER, HERBERT, evolutionary philosopher, was born at Derby on April 27, 1820. His father was a school teacher of liberal views in religion and politics, and after receiving instruction from him and attending a day-school, he was placed under the care of his uncle, the Rev. Thomas Spencer, perpetual curate of Hinton, near Bath, a strong radical and a Chartist. After three years at Bath he returned to Derby, where he taught in a school for a short time,

till in 1837 he was employed on the London and Birmingham Railway, then in course of construction. He was next connected with the Birmingham and Gloucester Railway, but the crash in railway speculation in 1845 left him without a situation. By this time he had begun to turn his thoughts seriously to sociological inquiries, and in 1842 he contributed to *The Nonconformist* a series of articles on *The Proper Sphere of Government*, which were published in pamphlet form in the following year. In these he clearly enunciates his doctrine of governmental non-interference. From 1848 till 1853 he was sub-editor of *The Economist*, and during this time he contributed to the *Westminster* and other reviews, becoming the intimate friend of George Eliot while she was sub-editing the *Westminster*. *Social Statics* (1850) represents a fresh study on a wider basis of the problems dealt with in the articles of 1842. In it he distinctly adumbrates the doctrine of the survival of the fittest, and conceives progress as involving continual adjustment to environment. During the ten years from 1850 to 1860, when he issued the prospectus of the *Synthetic Philosophy*, the cardinal principles of his evolutionary system were rapidly taking definite shape. To this period belong the following essays or articles: *The Philosophy of Style* (1852); *The Development Hypothesis* (1852); *Over-Legislation* (1853); *The Universal Postulate* (1853); *The Genesis of Science* (1854); *Manners and Fashion* (1854); *Progress: its Law and Cause* (1857), in which he has already attained nearly all his leading positions; *Representative Government* (1857); *The Origin and Function of Music* (1857); *The Nebular Hypothesis* (1858); *The Physiology of Laughter* (1860); and *The Social Organism* (1860). All these, together with others, are contained in the collection of his *Essays, Scientific, Political, and Speculative* (three vols., 1892). He had treated of sociological and political questions in his earlier works, but subsequently he extended his survey to the problems of life and mind as lying at the root of any true sociology; and from 1860 onwards he elaborated and gave to the world his *System of Synthetic Philosophy*—a work carried out with health seriously impaired by overwork, and with no prospect of adequate remuneration or recognition. The volumes constituting the *Synthetic Philosophy* are the following, arranged in their systematic order: *First Principles* (1862; finally revised edn., 1900); *Principles of Biology* (two vols., 1867; revised and enlarged, 1898-99); *Principles of Psychology* (two vols., 1872), an enlarged and revised edition of *The Principles of Psychology* (1855); *Principles of Sociology* (three vols., 1877-96); and *Principles of Ethics* (two vols., 1892-93). *The Data of Ethics*, published in 1879, was a preliminary account of his ethical system, but is now incorporated in *The Principles of Ethics*. Only the briefest outline of Spencer's philosophy can be given here; for fuller accounts reference may be made to Fiske's *Outlines of Cosmic Philosophy* (two vols., 1874), Hudson's *Introduction to the Philosophy of Herbert Spencer* (1895), and Macpherson's *Herbert Spencer: the Man and his Work* (1900), as well as to the works themselves.

Spencer conceives philosophy as completely unified knowledge, as opposed to science, which is partially unified knowledge, and to the ununified fragments of ordinary knowledge. The task of the philosopher is to merge the generalizations of the special sciences in universal generalizations, and so completely unify and interrelate them. He clears the ground in the first part of *First Principles* by finding the reconciliation of science and religion in the recognition that the former deals only with the phenomenal world, or

the Knowable, and the latter only with the Unknowable ground of phenomena. He affirms the existence and reality of the Unknowable or Absolute as strongly as he denies all possibility of knowing anything of its nature. Thus, he speaks of 'an Absolute that transcends not only human knowledge but human conception'; and in another place he says: 'The interpretation of all phenomena in terms of Matter, Motion, and Force is nothing more than the reduction of our complex symbols of thought to the simplest symbols; and when the equation has been brought to its lowest terms, the symbols remain symbols still'. Again, he writes: 'By the persistence of Force we really mean the persistence of some Cause which transcends our knowledge and conception. In asserting it we assert an Unconditioned Reality, without beginning or end.' In his philosophy of the Knowable, which occupies all his works except a small part of *First Principles*, he develops his system both inductively and deductively, according to a regular plan which gives to his treatises a somewhat formal character. His highest principle, to which all the mutations of phenomena are ultimately reduced, is the Persistence of Force, which he gives as the last word of science proper in regard to the Cosmos. From it he deduces the principles called by him *The Instability of the Homogeneous*, *The Law of the Multiplication of Effects*, and *The Law of Segregation*, and from these deductively reaches the position that a constant redistribution of matter and motion in the Cosmos is a necessity. He conceives progress as involving a tendency towards individuation, and extends to all phenomena the principle of advance from homogeneity to heterogeneity. Motion takes the line of least resistance, and according to him is always and everywhere of a rhythmical character. Not only, however, does progress consist in advance from homogeneity to heterogeneity, but along with this change there proceeds another, which he calls a change from indefiniteness and independence of the parts to their greater definiteness, mutual dependence, and specialization. These changes in their totality he calls *Evolution*, which he defines as 'an integration of matter and concomitant dissipation of motion, during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity, and during which the contained motion goes through a parallel transformation'. He traces this process of evolution from the primeval, undifferentiated mass of the nebular hypothesis to the human soul with its conceptions of right and duty, through the phenomena of life, mind, and society. He is not a phenomenalist or naturalist in any strict sense. Causation is not merely, in his view, invariable sequence or co-existence, and the uniformity of nature is not purely a matter of uncontradicted experience. He does not resolve matter into mind, or mind into matter, but regards all the ultimates of science as merely symbols of an inscrutable reality, of an infinite, eternal energy. In one passage, indeed, he expresses the opinion that it is much more rational to conceive of the Ultimate Reality as mind than as matter. In ethics he seeks to reconcile the utilitarians with the intuitionists by developing the view that what is intuitive in the individual may be developed on a utilitarian basis in the race. He traces the genesis of the religious emotions to conceptions of the other-self generated by dreams, shadows, &c. In regard to the functions of the state, he believes that its sole function is regulative, its proper aim being to secure that condition of affairs represented by the formula, 'the liberty of each limited only by the equal liberty of all'. Existing states

interfere, as he thinks, too much where they ought to let alone, and not enough or not efficiently enough in the sphere which properly belongs to them. The direction of social progress he believes to be from union for primarily military purposes to union for primarily industrial purposes, and step by step with this progress there proceeds inevitably a movement towards a less regimented society and greater individual freedom. Any movement of temporary retrogression from the industrial to the military condition is accompanied by limitation of individual freedom and a growth of bureaucratic authority. On the merits of the system as a whole widely different views are held, but there can be no doubt that it constitutes in essence an abiding contribution of value to mankind's conception of the Cosmos. Spencer's other works include the following: Education: Intellectual, Moral, and Physical (1861), an admirable work, which has enjoyed greater popularity than any of his other works; The Classification of the Sciences (1864); The Study of Sociology (1873), in the International Scientific Series; Man versus the State (1884); The Factors of Organic Evolution (1886), now included in Essays; The Inadequacy of Natural Selection (1893); A Rejoinder to Weismann (1893); Various Fragments (1897); and Facts and Comments (1902), in which, among other things, he shows his strong opposition to the militarist and imperialist developments in modern Britain, particularly as he finds them manifested in the South African war. He also planned and superintended a large work called Descriptive Sociology, but after the issue of eight parts it was discontinued owing to inadequate financial support. It contains a vast mass of materials to serve as a basis for sociological inductions. Mr. Spencer has latterly lived at Brighton. He has consistently refused all honorary distinctions, and when they have been conferred without his sanction he has ignored them. He is unmarried.

**SPENNYMOOR**, a rising town of England, in Durham, 5 miles south of the city of Durham, with modern church and chapels, town-hall, market-halls, public park, &c. Collieries, blast-furnaces, &c., employ many of the inhabitants. Pop. (1901), 16,661.

**SPERMACEI**, a fatty material obtained chiefly from cavities in the skull of the sperm whale (which see).

**SPHENE**, a mineral composed of silicic acid, titan acid, and lime. Its colours are dull yellow, green, gray, brown, and black. It is found amorphous and in crystals. The primary form of its crystals is an oblique rhombic prism.

**SPHEROGRAPH**, a nautical instrument consisting of a stereographic projection of the sphere upon a disc of pasteboard, in which the meridians and parallels of latitude are laid down to single degrees. By the aid of this projection, and a ruler and index, the angular position of a ship at any place, and the distance sailed, may be readily and accurately determined on the principle of great-circle sailing.

**SPHINCTER**, in anatomy, a name applied generally to a kind of circular muscles, or muscles in rings, which serve to close the external orifices of organs, as the sphincter of the mouth, of the eyes, of the pylorus of the stomach, of the bladder, &c., and more particularly to those among them which, like the sphincter of the anus, have the peculiarity of being in a state of permanent contraction, independently of the will, and of relaxing only when it is required that the contents of the organs which they close should be evacuated.

**SPIDER-FLY**, a dipterous insect of the tribe Pupipara. There are many species of these found parasitic on birds and quadrupeds, and belonging to

several families, including Hippoboscidae, Nycteribiidae, and Braulidae. Sometimes the term is restricted to the genus *Ornithomyia* of the first-named family. Of this genus the best-known species is *O. avicularia*, a yellowish insect parasitic on many British birds.

**SPIEGELEISEN**, a peculiar kind of cast-iron made from specular iron ore, or hematite, containing a large percentage of carbon and manganese. Being remarkably free from impurities, as phosphorus, sulphur, silica, it is largely used in the Bessemer process of steel-making for the purpose of reintroducing carbon. See STEEL.

**SPIKE-OIL**, a volatile oil obtained by distilling *Lavandula Spica* (a species of lavender) with water. It has a less agreeable odour than true lavender-oil, and is specifically heavier. It is obtained from the leaves and stalks of the plant, true lavender-oil from the flowers.

**SPINDLE**, in spinning, a pendent piece of wood for twisting and winding the fibres drawn from the distaff; in spinning-wheels and machinery, the piece that twists the thread, carrying the bobbin on which, when twisted, it is wound. The term also denotes a measure of yarn: in cotton, 18 hanks or 15,120 yards; in linen, 24 heers or 14,400 yards. See COTTON-SPINNING.

**SPINE**, or **THORN**, in botany, a sharp process from the woody part of a plant. It differs from a *prickle*, which proceeds from the bark. A spine sometimes terminates a branch, and sometimes is axillary, growing at an angle formed by the branch or leaf with the stem. The wild apple and pear are armed with spines; the rose, bramble, gooseberry, &c., are armed with prickles. Leaves may also be reduced to spines, and in the common barberry (*Berberis vulgaris*) the transition from a spiny leaf to a leaf-spine is often plainly visible. The term is applied in zoology to a stout, rigid, and pointed process of the integument of an animal, formed externally by the epidermis and internally of a portion of the cutis or corresponding structure.

**SPINNING-JENNY**, **SPINNING-WHEEL**. See SPINNING, COTTON-SPINNING.

**SPIRIT-LEVEL**. See LEVEL (SPIRIT).

**SPIROMETER**, a contrivance for determining the capacity of the human lungs. The instrument most commonly employed consists of an inverted chamber submerged in a water-bath. The breath is conducted by a flexible pipe and internal tube, so as to collect in the chamber, which rises in the water, and is fitted with an index marking the number of cubic inches of air expired after a forced inspiration.

**SPLEENWORT**, the common name of various British ferns of the genus *Asplenium*, forming the type of the division Aspleneae of the family Polypodiaceae. These plants were so named because they were supposed to remove disorders of the spleen. They grow upon rocks and old walls.

**SPLINT**, in surgery, a thin piece of wood or other substance, used to hold or confine a broken bone when set, or to maintain any part of the body in a fixed position. There are various kinds of splints, adapted for different purposes. A *plaster-of-Paris splint* is made by charging a bandage of muslin or other open material with plaster of Paris, and washing over each layer with water. The plaster hardens rapidly.

**SPODE** (from Gr. *spodos*, ashes), a material composed of calcined ivory of which vases and ornaments are made.

**SPOKANE**, a city of the United States, capital of Spokane county, in the state of Washington, on both banks of the Spokane River. It was settled in

1878, and destroyed by fire in 1889, since when it has been rebuilt. It is situated in a fine agricultural region, and two large falls on the river within the city boundaries provide power for its manufactories, electric-lighting, cable and electric tramways. Among its chief buildings are the high-school and the opera-house. Pop. (1890), 19,922; now about 25,000.

**SPORANGIUM**, in botany, the case in which the spores or non-sexual reproductive germs of cryptogams are formed. In ferns the sporangia are often grouped in clusters on the under-side of the frond, each cluster being known as a *sorus*. Each sporangium is surrounded by a ring of specially-formed cells, called the *annulus*, which is much thinner at one part of the surface; and when the sori are ripe the sporangium bursts at the weaker part of the annulus, owing to unequal contraction in drying, and liberates the spores. See **BOTANY**.

**SPOTTISWOODE, WILLIAM**, mathematician and physicist, was born in London on Jan. 11, 1825, and died on June 27, 1883. He received his earlier education at Laleham, Eton, and Harrow, whence in 1842 he proceeded to Balliol College, Oxford. In 1845 he graduated with first-class honours in mathematics, and in the following year became manager of his father's printing establishment. He was the author of *A Tarantasse Journey through Eastern Russia* (1857); *Meditationes Analyticae* (1847); *Elementary Theorems relating to Determinants* (1851; revised and enlarged in *Crelle's Journal*, 1856); a treatise on *The Polarization of Light* (Nature Series, 1874); lecture on the *Electrical Discharge: its Form and Functions* (1881); several papers to the Geographical Society, one of which was on *Typical Mountain Ranges*; and a paper to the *Astronomical Society* on a *Method of Determining Longitude*. He was president of the *London Mathematical Society* (1870-72), of the *British Association* (1878), and of the *Royal Society* (1878). In mathematics he is chiefly distinguished as one of the first to make extensive use of the symmetrical determinant notation, and as the author of a series of papers in the *Philosophical Transactions* of 1862 and the following years on the contact of curves and surfaces. In physics he devoted himself mainly to the study of polarized light and electrical discharge through rarefied gases.

**SPREMBERG**, a town of Prussia, in the province of Brandenburg, on the Spree, 14 miles south of Kottbus, with woollen and other manufactures. It consists of an older portion situated on an island in the Spree, and a larger and more regularly built newer portion on the western bank of the river. Pop. (1895), 11,122.

**SPRINGFIELD**, a city of the United States, capital of Greene county, Missouri, 130 miles south of Jefferson City, on the summit of the Ozark Mountains, in the midst of rich lead and zinc mines. It has railway works, flour-mills, tobacco-factories, iron-foundries, &c. Pop. (1890), 21,850.

**SPROTtau**, a town of Prussia, in the province of Silesia, district of Liegnitz, at the confluence of the Sprötte with the Bober. It has manufactures of tobacco, cigars, artificial flowers, &c., and there are large mill-works, breweries, &c. Pop. (1895), 7676.

**SQUETEAGUE**, an American fish, the *Otolithus regalis* of Cuvier and *Cynoscion regalis* of later ichthyologists, very common in the waters of Long Island Sound and adjacent bays, where it is captured in large quantities for the table. It produces a dull sound like that of a drum. It is of a silvery colour, darker above, and covered with many dark blotches; and has a projecting head with a prominent lower jaw.

**SSUMAO, SUMAO, SEMAO, or SEEMAO**, a treaty port of China, in the south of the province of Yunnan, about 100 miles east of the Mekong River. It has a frontier trade in tea and a small foreign trade. Pop. 15,000.

**STAHR, ADOLF WILHELM THEODORE**, German writer, was born at Prenzlau on Oct. 22, 1805, and died in Wiesbaden on Oct. 3, 1876. He was educated at Halle, and was for a number of years co-rector of the gymnasium at Oldenburg, but latterly resigned this post on account of ill health, and settled in Berlin. His earlier works were connected with Aristotle and his philosophy, and included *Aristotelia* (1830-32); *Aristoteles bei den Römern* (1834); and translations of the *Politics*, *Poetics*, *Rhetoric*, and *Ethics*; but latterly his literary activity extended over a wide field. Of his numerous other works we may mention *Ein Jahr in Italien* (1847-50); *Die Republikaner in Neapel* (1849), a novel; *Torso—Kunst, Künstler und Kunstwerke der Alten* (1854-55); *Lessing, sein Leben und seine Werke* (1859); *Fichte* (1862); *Goethes Frauengestalten* (1865-68); *Die Preussische Revolution* (1850); *Weimar und Jena* (1852); *Zwei Monate in Paris* (1851); *Nach fünf Jahren, Pariser Studien* (1857); *Herbstmonate in Oberitalien* (1860); *Ein Winter in Rom* (1869); *Aus der Jugendzeit* (1870-77); *Bilder aus dem Altertum* (1868-66); and *Römische Kaiserfrauen*, &c. In 1854 he married Fanny Lewald, who was also known as an authoress.

**STAINED-GLASS**. See **GLASS-PAINTING**.

**STAINER, SIR JOHN**, musician and composer, was born in London in 1840, and at the age of seven became a chorister in St. Paul's cathedral. In 1856 Sir Frederick Ouseley appointed him organist of his newly-founded college at Tenbury, and three years later he became organist of Magdalen College, Oxford. At Oxford he took his bachelor's degree in music in 1859, and in arts in 1863, proceeding Mus. Doc. in 1865, and M.A. in 1866. From 1863 till 1872 he was university organist, and from the latter year till his resignation in 1888 he held the post of organist in St. Paul's, London. In this position he achieved great success, and contributed much to the improvement of the musical part of the service in the cathedral. In 1881 he succeeded the late Sir Arthur Sullivan in the principality of the National Training School, and in 1882 he received the appointment of inspector of music in the elementary schools of England. He was professor of music in the University of Oxford from 1889 till his resignation in 1899. Dr. Stainer received many honours, including that of knighthood in 1888. He died on April 1, 1901. He was an eminent organist, a composer of considerable ability, and a writer of works on music. His principal compositions are cantatas entitled *The Daughter of Jairus* (1878), *St. Mary Magdalen* (1883), and *The Crucifixion* (1887), and many anthems, songs, hymn tunes, organ pieces, &c. His writings include various musical primers, a *Dictionary of Musical Terms* (in collaboration with W. A. Barrett), and a valuable work on fifteenth-century music entitled *Early Bodleian Music: Dufay and his Contemporaries*.

**STAINES**, an old market-town of England, in Middlesex, on the Thames, 6 miles to the south-east of Windsor, and about 19 miles s.w. of London. It is said to be named from a stone which formerly marked the limit of the jurisdiction of the London Corporation. A bridge connects it with Egham in Surrey. Mustard, linoleum, and beer are manufactured. Pop. (1891), 5060; (1901), 6688.

**STALIMENE**. See **LEMNOS**.

**STANDISH**, an urban district of England, in Lancashire, 3 miles north by west of Wigan, with extensive collieries, the Wigan water-works, &c. Pop. (1891), 5416; (1901), 6308.

**STANFIELD, CLARKSON**, a distinguished painter, more particularly of sea-pieces, was born in Sunderland on Dec. 3, 1793, and spent the early part of his career at sea, serving for a time in the same ship with Douglas Jerrold. While at sea his talent for painting and drawing attracted the attention of Captain Marryat, who met Stanfield serving as captain's clerk in a king's ship in the Mediterranean. What has been called a 'lucky tumble' from the mast-head caused him to leave the navy and devote himself to painting for a livelihood. As with Hunt, Roberts, and Brough, theatrical scene-painting became the primary field for the display of his powers. His first exhibited easel picture was *A River Scene*, shown at the Royal Academy in 1820; this was followed by *St. Bernard's Well*, near Edinburgh (1821); *Ben Venue*; *A Coast Scene*; and in 1827 his earliest important picture, *Wreckers off Port Rouge*, which was exhibited at the British Institution. He was one of the foundation members of the Society of British Artists, and continued in this connection till the success of his *Mount St. Michael*, Cornwall, which was exhibited at the Academy in 1830, gave promise that he would be received in the ranks of the Royal Academy. He was elected A.R.A. in 1832 and R.A. in 1835. He was commissioned by William IV. to paint the Opening of the New London Bridge (1832) and Portsmouth Harbour. For the Marquis of Lansdowne's banqueting-room at Bowood he painted ten large pictures of Venetian scenes, and a similar series for the Duke of Sutherland's house at Trentham. Among his other important pictures are *The Battle of Trafalgar*, *The Abandoned*, *The Day after the Wreck*, *The Victory towed into Gibraltar after Trafalgar*, *The Bass Rock*, &c. He died 18th March, 1867, and was buried in the Roman Catholic cemetery, Kensal Green. He has been called the English *Vanderveelde*. His son **GEORGE CLARKSON STANFIELD** (1828-78) inherited much of his genius as a landscape-painter.

**STANFORD, SIR CHARLES VILLIERS**, English composer, son of an Irish chancery lawyer, was born in Dublin on Sept. 30, 1852. He entered Queen's College, Cambridge, in 1870, but soon afterwards removed to Trinity College, where he was appointed organist in 1873. He graduated with honours in classics in 1874, and proceeded M.A. three years later. He continued his musical studies at Leipzig and Kiel, and in 1877 a festival overture in B flat by him was performed at the Gloucester Festival, and a symphony at the Crystal Palace. Since that date he has produced numerous compositions in different styles, several of which have achieved a considerable degree of popularity. His best-known work is probably his choral setting of Tennyson's ballad of *The Revenge*, which was produced at the Leeds Festival in 1886. Tennyson's works have provided him with the material for several of his other compositions, including the *Carmen Sæculare* (1887), *The Voyage of Mældune* (1888), the music for *Becket* (1893), and songs from *The Princess* (1898). His operas include *The Veiled Prophet of Khorassan*, produced at Hanover in 1881, and in England for the first time in 1893; *Savonarola*, first produced at Hamburg in 1884; *Shamus O'Brien* (1896), the most successful; and *Much Ado About Nothing* (1901). In oratorio he has done some good work, including *The Three Holy Children* (1885), and *Eden* (1891), both written for Birmingham Festivals. His symphonies

are: an *Elegiac Symphony* (1882); an *Irish Symphony* (1887); a *Symphony in F* (1888), first produced in Berlin; and *L'Allegro ed il Penseroso* (1895). The most important of his other works may be thus enumerated: some collections of songs; a setting of Whitman's *Elegiac Ode on the death of Lincoln*, produced at the Norwich Festival in 1884; settings of the three cavalier songs by Browning (1884); music for *Æschylus's Eumenides* (1885) and *Sophocles's Oedipus Rex* (1887); settings of some psalms; a violin suite (1888); *The Battle of the Baltic* (1891), a ballad for chorus and orchestra, produced at a Hereford Festival; string quartets; pianoforte sonatas; *East to West* (1893), an ode on the opening of the Chicago exhibition, the words being by Swinburne; masses; Irish fantasies for the violin (1894); a setting of Gray's *The Bard*, first given at the Cardiff Festival of 1895; a pianoforte concerto (1895); Phaudrig Coshona (1896), a choral ballad, first produced at a Norwich Festival; a Requiem, performed at the Birmingham Festival of 1897 in memory of Lord Leighton; a *Te Deum* in honour of Queen Victoria's Diamond Jubilee, first performed at the Leeds Festival of 1898; and a setting of Mr. Henley's patriotic poem *The Last Post*, produced at Hereford in 1900. On the foundation of the Royal College of Music, in 1883, Dr. Stanford was appointed its professor of composition and orchestral playing, and in 1887 he succeeded Macfarren as professor of music at Cambridge. He has been conductor of the Bach Choir since 1885, and in 1897 he was appointed conductor of the Leeds Philharmonic Society. He was knighted in 1902.

**STANLEY**, a town of England, in Yorkshire (W. Riding), on the river Calder, 3 miles north of Wakefield, with brick-works, collieries, alum-works, &c. Pop. (1891), 10,297; (1901), 12,158.

**STANLEY, REV. ARTHUR PENRYN, D.D.**, second son of Edward Stanley, rector of Alderley, afterwards bishop of Norwich, was born at Alderley, Cheshire, on Dec. 13, 1815, and died in London on July 18, 1881. He was educated first in a private school at Seaforth, and afterwards at Rugby, where he conceived an abiding love and veneration for Dr. Arnold, and gained a unique position in the school. In 1834 he entered Balliol College, Oxford, where he took a first-class in Classics, and gained the Newdigate prize for a poem entitled *The Gypsies*. In 1838 he was elected a fellow of University College, and two years afterwards he set out on a tour through Switzerland and the classical countries. Ordained in 1839, he took priest's orders and became a college tutor in 1843, and he was appointed in 1845 preacher to Oxford University. In that capacity he preached four sermons, which were published, under the title *Sermons on the Apostolical Age*, in 1847, at a critical time in the religious history of Oxford. In these Stanley stood aloof from both the evangelicals and the high churchmen, taking up a sort of rationalistic position. In 1850 he was appointed secretary of the Oxford University Commission, and he was presented to a canonry of Canterbury in 1851. Shortly afterwards he travelled extensively in Palestine and Egypt. In 1856 he was appointed professor of ecclesiastical history at Oxford and canon of Christ Church, and in 1862 he accompanied the Prince of Wales to the East; while in the following year he was, not without opposition, appointed dean of Westminster. In this position he exercised an important influence, though the width of his sympathy and his tolerant spirit exposed him to attacks from many of narrower views within the Church. In 1863 he married Lady Augusta Bruce, daughter of the seventh Earl of

Elgin (died 1876), to whom he owed much of his social popularity. He was the author of numerous works, of which may be mentioned: *Life of Arnold* (1844); *Memoir of Bishop Stanley* (1850); *Memorials of Canterbury Cathedral* (1854); *Commentary on the Epistles to the Corinthians* (1855); *Sinai and Palestine* (1856); *Three Introductory Lectures to the Study of Ecclesiastical History* (1857); *Lectures on the History of the Eastern Church* (1861); *Lectures on the History of the Jewish Church* (1863-76); *Sermons in the East* (1863); *Memorials of Westminster Abbey* (1868); *Essays, chiefly on Questions of Church and State from 1850 to 1870* (1870); *The Athanasian Creed* (1871); *Lectures on the History of the Church of Scotland* (1872); *Addresses and Sermons delivered at St. Andrews* (1877); *Addresses and Sermons delivered in the United States and Canada* (1879); and *Christian Institutions* (1881). The breadth and tolerance characteristic of Stanley's religious views were well shown in his attitude towards Bishop Colenso, whom he supported without endorsing his opinions on the Pentateuch, and in his article on the famous *Essays and Reviews* contributed to the *Edinburgh Review* of April, 1861. See Bradley's *Recollections of Arthur Penrhyn Stanley* (1883); *Prothero's Life and Correspondence of Dean Stanley* (1893), and *Letters and Verses of Dean Stanley* (1895).

STANLEY, SIR HENRY MORTON, African explorer, was born near Denbigh, Wales, on Jan. 28, 1841, and was placed in the poorhouse of St. Asaph at the age of three. Subsequently, in 1856, he went as cabin-boy to New Orleans, and was there adopted by a merchant, whose name he assumed, discarding his own name of John Rowlands. His adoptive father having died intestate, Stanley enlisted in the Confederate army, and was taken prisoner, but after his discharge he volunteered into the United States navy, and became an ensign on the iron-clad *Ticonderoga*. At the close of the war he went to Turkey as a newspaper correspondent, and as war correspondent for the *New York Herald* he joined the Abyssinian expedition of 1867-68. He afterwards travelled in Spain, and it was while there in 1869 that he was asked by the proprietor of the *New York Herald* 'to go and find Livingstone'. After visiting the Crimea, Palestine, Persia, and India, he reached Zanzibar in the early part of 1871, and from thence he proceeded across Africa in search of Livingstone. He met and relieved the traveller at Lake Tanganyika in November of the same year, and then returned to England. He next acted as the *Herald's* correspondent during the Ashantee war (1873-74). As correspondent of the *Daily Telegraph* and the *New York Herald* he in 1874 undertook an expedition into Africa, where he explored the equatorial lake region and for the first time traced the Congo River from the interior to its mouth (1877). For the purpose of developing this vast region he returned in 1879 under the auspices of the International African Association, founded by the King of the Belgians, and after planting stations and establishing steam navigation this territory secured by Stanley was named in 1885 the Congo Free State. In 1887 he organized an expedition for the relief of Emin Pasha, who after the Mahdist rising in the Soudan was cooped up with his Egyptian followers in the Equatorial Province of Egypt at Wadelai, north of Lake Albert Nyanza. This time he entered Africa on the west by way of the Congo; and after a series of extraordinary marches through a forest region, accompanied with great hardships, he met Emin Pasha in the neighbourhood of the Albert Nyanza. After a return

journey to bring up the rear-column, which he had left in charge of Major Barttelot on the Aruwimi, Stanley finally, in May, 1889, set out from the Albert Nyanza, and brought the pasha and his followers to Bagamoyo in January, 1890. On his return to Britain he undertook a lecturing tour, and was overwhelmed with honours in all parts of the country. In 1895-1900 he represented Lambeth in the House of Commons in the Liberal Unionist interest. He is the author of *How I Found Livingstone: Travels, Adventures, and Discoveries in Central Africa*; including *Four Months' Residence with Dr. Livingstone* (1872); *Coomassie and Magdala: The Story of Two British Campaigns in Africa* (1874); *Through the Dark Continent: or the Sources of the Nile around the Great Lakes of Equatorial Africa, and down the Livingstone River to the Atlantic Ocean* (1878); *The Congo, and the Founding of its Free State: a Story of Work and Exploration* (1885); in *Darkest Africa: or The Quest, Rescue, and Retreat of Emin, Governor of Equatoria* (1890); *Slavery and the Slave Trade in Africa* (1893); and *Through South Africa* (1898). In 1899 he was created G.C.B.

STANLEY FALLS, STANLEY POOL. See CONGO FREE STATE.

STAPHYLOMA, a name given to different tumours of the anterior surface of the globe of the eye. It is a very disfiguring affliction, and in some cases the eyeball has to be entirely removed in order to prevent the other eye from becoming affected. It is called also *staphylosia*.

STARBUCK ISLAND, an uninhabited British island in the Pacific Ocean, situated in lat. 5° 30' N. and lon. 155° W. It is about 5 miles long by less than 2 broad. Guano was formerly obtained from it, but the supply has been exhausted.

STAR-THISTLE, a British plant (*Centaurea Calcitrapa*) which grows in gravelly, sandy, and waste places in the middle and south of England, especially near the sea, and is remarkable for its long spreading spiny bracts. The *yellow star-thistle* (*Centaurea solstitialis*) is occasionally seen in fields and waste places, principally in the east and south of England, and near Dublin. It is also called *St. Barnaby's thistle*. These thistles do not belong to the true thistles, but to an allied genus.

STARWORT, the popular name of several plants, some of them belonging to the genus *Stellaria*, or that of chickweed. *Sea Starwort* is a British herbaceous, composite plant of the genus *Aster*, the *A. Tripolium*. It has pale blue flowers with a yellow disc, and grows in salt marshes. The name *water starwort* is sometimes given to *Callitriche aquatica*.

STASSFURT, a town of Prussia, province of Saxony, district of Magdeburg, on the Bode, famous for its great deposits of rock-salt, potassium and other salts (including carnallite, kainite, kieserite, &c.). The working of these salts is a very important industry, the products including potash, epsom-salts, glauber-salts, sulphate of potash, chloride of magnesium, bromine, &c. Pop. (1895), 18,981; (1900), 20,031.

STEAM-WHISTLE, an arrangement connected with the boiler of a steam-engine for the purpose of making a loud whistling sound. In the locomotive steam-whistle a tube, fixed to the head of the boiler and opening into its interior, is commanded by a stop-cock; the tube ends in a portion perforated with holes and surrounded by a thin brass cup; and the tube and cup are so adjusted as to leave a narrow opening all round. Above this opening a thin brass cup is fixed in an inverted position so as to present a sharp edge to the orifice. When the

stop-cock is opened the steam rushes through this orifice with great violence, and in coming in contact with the sharp edge of the cup it produces a loud shrill sound. Steam-whistles can be made to give off musical tones by graduating the length of the pipe or cup.

**STEELL, SIR JOHN, R.S.A.**, sculptor, was born in Aberdeen on Sept. 18, 1804. He received his art education in Edinburgh, where his family had removed, and afterwards studied in Rome. He returned to Scotland in 1833 and established himself in Edinburgh, where he soon afterwards executed a colossal statue of Alexander taming Bucephalus. This group, which was cast in bronze and erected in Edinburgh, first brought him into public notice. His popularity was further increased by a commission for a statue of the Queen, which now occupies the front of the Royal Institution, and by his success in the competition for a statue of Sir Walter Scott to be placed in the Edinburgh monument. Further commissions flowed in, among which the following may be mentioned:—A statue of the Duke of Wellington, erected in front of the Register House, Edinburgh; a statue of Admiral Lord de Saumarez, placed in Greenwich Hospital; of Lord Melville, and Lord Jeffrey; a monument to the 93rd Highlanders for Glasgow Cathedral; a statue of Dr. Thomas Chalmers, and one of Professor Wilson, for Edinburgh; and a statue of Burns erected in Central Park, New York. His chief work, however, was the national memorial to the Prince Consort, which was unveiled by the Queen in Edinburgh, August, 1876, and procured him the honour of knighthood. In 1829 he became a Royal Scottish Academician, and nine years later he was appointed sculptor to the queen in Scotland. His death took place at Edinburgh on 15th September, 1891.

**STEEVENS, GEORGE**, a Shaksperian critic, was born at Poplar on May 10, 1736, and died at Hampstead on Jan. 22, 1800. He was educated at Eton and King's College, Cambridge, but did not take a degree, and in 1766 he published *Twenty of the Plays of Shakspeare* in four vols. After this he was associated with Dr. Johnson in an edition of *Shakspeare* published in 1773. He then prepared (1793) a corrected text, with notes, of the dramatist's works in fifteen vols., which remained for a long time the standard edition. He made many enemies by his acrimonious and ill-natured attacks on contemporary editors and others, but his contribution to Shaksperian criticism has permanent value.

**STEPHANSPORT**, the capital (since 1896) of German New Guinea, at the head of Astrolabe Bay. Cotton, coffee, tobacco, &c., are grown in the neighbourhood.

**STEPHEN, SIR JAMES**, under-secretary for the colonies, was born in London on Jan. 3, 1789, and died at Coblenz on Sept. 14, 1859. He was educated at Trinity Hall, Cambridge, was called to the bar in 1811, practised as a barrister, became in 1834 assistant under-secretary of state, and in 1836 under-secretary for the colonies, and on his retirement in 1847 he was created K.C.B. Two years afterwards he was appointed professor of modern history in Cambridge University. From 1855 till 1857 he was also a professor at the East India College, Haileybury. He was the author of *Essays in Ecclesiastical Biography* (1849) and *Lectures on the History of France* (1852).—His brother, **SIR GEORGE**, born in 1794, died at Melbourne on June 20, 1879, after studying medicine became an attorney, and latterly in 1849 a barrister. He distinguished himself as an advocate for the abolition of slavery, and in bringing about reforms in connection with the police force and pauper relief; and was knighted in 1837.

From 1855 he lived in comparative retirement at Melbourne. Some of his works are: *Practical Suggestions for the Improvement of the Police* (1829); *Adventures of a Gentleman in Search of a Horse*, by Caveat Emptor (1835); *The Jurymen's Guide* (1845); *The Principles of Commercial Law explained in a Course of Lectures* (1853); *Anti-Slavery Recollections* (1854), letters to Mrs. H. B. Stowe; *Life of Christ* (1871).—**SIR JAMES FITZJAMES STEPHEN**, an eminent judge, son of Sir James, was born at Kensington on Mar. 3, 1829, and died at Ipswich on Mar. 11, 1894. He was educated at Brighton, Eton, King's College, London, and Trinity College, Cambridge, and was called to the bar in 1854. He became recorder of Newark-on-Trent in 1859, and was legal adviser to the Indian Council from 1869 till 1872. In 1875 he was appointed professor of common law at the Inns of Court; and four years later a judge of the High Court of Justice. He resigned his judgeship in 1891. He was the author of *Essays of a Barrister* (1862); *General View of the Criminal Law of England* (1863); *Liberty, Equality, and Fraternity* (1873); *A Digest of the Law of Evidence* (1876); *A Digest of the Criminal Law* (1877); *History of the Criminal Law of England* (1883); *The Story of Nuncomar and Sir Elijah Impey* (1885); and *Horæ Sabbaticæ* (1892), articles from the *Saturday Review*. He was created K.C.S.I. in 1877. See his *Life* by Leslie Stephen (1895).—**HENRY JOHN**, a brother of Sir James and Sir George, serjeant-at-law, was born at St Christopher's, West Indies, on Jan. 18, 1787, and died at Clifton on Nov. 28, 1864. He studied at St. John's College, Cambridge, and was called to the bar in 1815; was author of *New Commentaries on the Laws of England* (four vols., 1841–45), often republished and quoted as a standard authority. Other works are a *Treatise on the Principles of Pleading in Civil Actions* (1824); and *Summary of the Criminal Law* (1834).

**STEPHEN, SIR LESLIE**, English author, a brother of Sir James Fitzjames Stephen, was born in London on Nov. 28, 1832. Educated at Eton and King's College, London, he proceeded to Trinity Hall, Cambridge, where he graduated B.A. in 1854 and M.A. in 1857. He became a fellow and tutor of his hall, and in 1883–84 he was Clark lecturer on English literature at Cambridge. He edited the *Cornhill Magazine* from 1871 till 1882, and in the latter year he undertook the editing of the great *Dictionary of National Biography* published by Smith, Elder, and Co. In 1890 Mr. Sidney Lee became associated with him in the editorship, and in the following year Mr. Stephen resigned altogether his editorial connection with the undertaking, though he continued to contribute numerous important biographies. His first publication was *The Playground of Europe* (1871), containing accounts of mountaineering experiences in the Alps. It was followed by *Essays on Freethinking and Plain Speaking* (1873), a collection of review articles, and by the first series of *Hours in a Library* (1874), appreciations reprinted from the *Cornhill* and other similar periodicals. His subsequent works include: *Hours in a Library* (2nd series, 1876; 3rd series, 1879); *History of English Thought in the Eighteenth Century* (two vols., 1876), dealing mainly with the development of theological belief; *Samuel Johnson* (1878), *Alexander Pope* (1880), and *Swift* (1882), in the *English Men of Letters* series; *The Science of Ethics* (1882); *Life of Henry Fawcett* (1885); *An Agnostic's Apology* (1893); *Life of Sir James Fitzjames Stephen* (1895); *Social Rights and Duties* (1896); *Studies of a Biographer* (1898); and *The English Utilitarians* (two vols., 1900), a work of

the greatest importance written by a utilitarian who has incorporated into his system the assured elements of the evolutionary philosophy. He has also edited the works of Fielding and the Letters of John Richard Green (1901). In 1902 he was created K.C.B. His first wife was Thackeray's youngest daughter.

STEVENS, ALFRED, artist, was born at Blandford, Dorsetshire, in 1818, and died in London on May 1, 1875. He was educated at the village school, and for a time followed his father's trade of house-painter. The assistance of a friend enabled him to study painting, architecture, and sculpture in Italy, where he lived from 1833 till 1842, being for some time a pupil of Thorwaldsen. After his return to England he lived at Blandford for two years and then came to London, where he became a teacher for two years in the School of Design. He next worked at Sheffield (1850-52), but returned to London and devoted himself to various branches of art, including portraits and numerous decorative designs, but his great work is the monument to the Duke of Wellington in St. Paul's. Stevens was a great but unappreciated genius. See Stannus's Alfred Stevens and his Work (1891), Armstrong's Alfred Stevens: a Biographical Study (1881).

STEWART, BALFOUR, physicist, was born at Edinburgh on Nov. 1, 1828, and died near Drogheda on Dec. 19, 1887. He was educated at Dundee and at the Universities of St. Andrews and Edinburgh. He engaged in mercantile affairs, and went to Australia for a short time, but on his return he abandoned mercantile pursuits and was appointed successively assistant in Kew Observatory, assistant to Professor Forbes in Edinburgh, director of Kew Observatory (1859), and professor of physics in Owens College, Manchester (1870), holding the latter post till his death. His chief earlier work was done in connection with radiant heat, and earned for him in 1868 the Rumford medal of the Royal Society; but latterly he mainly devoted himself to the study of terrestrial magnetism and meteorology. Among his numerous writings are: *An Elementary Treatise on Heat* (1866); *Lessons on Elementary Physics* (1870); *Conservation of Energy* (1872); *The Unseen Universe* (1875) and the *Paradoxical Philosophy* (1878), both in conjunction with Professor Tait; and *Practical Physics* (1885-87), in conjunction with Professor Gee.

STEWART, SIR DONALD MARTIN, soldier, was born near Forres on Mar. 21, 1824, and educated at Aberdeen University. He entered the Bengal Staff Corps in 1840, served against the hill tribes in Peshawur, took part in the suppression of the Indian mutiny in 1857, and in the Abyssinian expedition of 1867-68. In the mutiny operations he gained great distinction and was rapidly promoted, and in 1877 he was appointed lieutenant-general. He commanded the Candahar column in the Afghan campaign of 1878-80, and marched with the field force from Candahar to Cabul, defeating the Afghans at Ahmed Kheyl and Oorzo. He commanded the troops in Northern Afghanistan till their final withdrawal. In 1869-74 he was chief commissioner of the Andaman and Nicobar Islands, and in 1881-85 Commander-in-chief in India. During the ten years from 1885 till 1895 he was a member of the Indian Council. In 1881 he was gazetted G.C.B. and created a baronet, and in 1894 he was promoted to the rank of field-marshal. He died at Algiers on Mar. 26, 1900.

STING-RAY, a fish belonging to the genus *Trygon*, of the natural order Elasmobranchii, family Trygonidae, which is allied to that of the rays proper. It is remarkable for its long, flexible, whip-like tail,

which is armed with a projecting bony spine, very sharp at the point, and furnished along both edges with sharp cutting teeth. Only one species (*T. pastinaca*) occurs in the British seas, and is popularly known as the *fire-faire*. Another species (*T. centrurus*) is common on the eastern coasts of North America. These fishes sometimes inflict serious wounds with their tail.

STIRLING, JAMES HUTCHISON, Scottish writer on philosophical and other subjects, was born in Glasgow on June 22, 1820. He studied in arts and medicine at the University of Glasgow, and afterwards resided for some time on the Continent. He practised as a physician till his father's death in 1851, but since then he has devoted himself exclusively to philosophical and literary studies. In 1865 he published an acute criticism of Hamilton, entitled *Sir William Hamilton, being the Philosophy of Perception: An Analysis*; but of much greater importance was his other work of the same date, *The Secret of Hegel*, to which the rise of the Hegelian school in Scottish and English philosophy may be justly ascribed. In 1867 he issued an annotated translation of Schwegler's *History of Philosophy* (12th ed., 1893), and among his subsequent philosophical works are: *An Address on Materialism* (1868); *As regards Protoplasm in Relation to Prof. Huxley's Essay on the Physical Basis of Life* (1869; new ed., 1872); *Lectures on the Philosophy of Law* (1873), an exposition of Hegel's *Rechtsphilosophie*; *Text-Book to Kant: The Critique of Pure Reason: Aesthetic, Categories, Schematism: Translation, Reproduction, Commentary, Index, with Biographical Sketch* (1881); *Philosophy in the Poets* (1885); *Philosophy and Theology* (1890), his Gifford lectures of 1889; *Darwinianism: Workmen and Work* (1894), a penetrating criticism of one type of evolutionary philosophy; and *What is Thought? or The Problem of Philosophy: by way of a General Conclusion so far* (1900). His other works comprise: *Jerrold, Tennyson, and Macaulay*, with other *Critical Essays* (1868); *Burns in Drama*, together with *Saved Leaves* (1878); *The Community of Property* (1885); and *Thomas Carlyle's Counsels* (1886). In 1867 the University of Edinburgh conferred upon him the honorary degree of LL.D.

STIRLING-MAXWELL, SIR WILLIAM, BART., M.P., K.T., long known as William Stirling of Keir, an accomplished man of letters and art-critic, was born at Kenmure, near Glasgow, on Mar. 8, 1818. His father was Archibald Stirling of Keir, and his mother a daughter of Sir John Maxwell of Pollok, Bart. He was educated at Olney, Bucks, and at Trinity College, Cambridge, where he graduated in 1839. In early life he travelled much in Spain and the Holy Land, and made an especial study of the masterpieces of art and literature of the first-mentioned country, the results of which appeared in his *Annals of the Artists of Spain* (three vols. 8vo, 1848), with portraits, a work full of amusing anecdote; and in his *Cloister Life of the Emperor Charles V.* (1852), which was received with much favour by the public. In 1855 he published *Velazquez and his Works*, in which the court life of Philip IV. is depicted; and in 1856 *Notices of the Emperor Charles V.* in 1555 and 1556, selected from the Despatches of Frederigo Badoer, ambassador from the Republic of Venice to the court of Brussels. He printed in a luxurious style several other works, intended mainly for private circulation, among others *Examples of Ornamental Heraldry of the Sixteenth Century* (1867), and a facsimile of the anatomical plates of Vesalius, with a life of Vesalius (1874). For the Philobiblon Society he edited in 1862 the *Marquis of Villars' Memoirs of*

the Spanish Court, 1678–82, and he also prepared a work entitled *Don John of Austria, or Passages from the History of the Sixteenth Century*, but it was unfinished at his death. It was published in two volumes in 1883 under the editorship of Sir G. W. Cox. He also wrote some poems. In 1865 Sir William married Lady Anna Maria Leslie Melville, who died in 1874, leaving two sons; and on 1st March, 1877, he married the Honourable Mrs. Norton, who died in the June following. In 1865 he succeeded his uncle, Sir John Maxwell, in the baronetcy and lands of Pollok, and was henceforth known as Sir William Stirling-Maxwell. In 1852 he was elected Conservative member for Perthshire, and again on several subsequent occasions. He died at Venice, January 15, 1878. His chief works were republished in 1891.

**STITCHWORT**, the name of several species of plants of the genus *Stellaria*, belonging to the natural order Caryophyllaceæ. The Greater Stitchwort (*S. Holostea*) is a frequent ornament of hedges and other shady places in the spring. It has narrow, grass-like leaves, and white flowers with five sepals, five deeply-cleft petals, ten stamens, and three styles. *S. graminea*, another British species, is known as the Lesser Stitchwort, and *S. media*, with a single line of hairs on the stem, is the common chickweed.

**STOCK-DOVE** (*Columbaenas*), a wild European pigeon about 18 inches in length, and with a general bluish-gray plumage, the breast being purplish. It raises two or three broods in a season, and builds its nest in the hole of a tree, in a rabbit-burrow, and in similar places. It is found in England, especially in the southern counties, but not in Scotland. See **PIGEON**.

**STOCKS, LUMB**, engraver, was born near Halifax on Nov. 30, 1812, and died in London on April 28, 1892. He was educated at Horton, near Bradford, and in 1827 he went to London, where he studied engraving, and was for a time chiefly engaged on plates for the annuals and similar publications. Subsequently he executed many line engravings for the *Art Journal* and several art-unions, and engraved many important works by Webster, MacIise, Wilkie, Mulready, Faed, Frith, E. M. Ward, Horsley, Noel Paton, Leighton, Millais, &c. He was elected an associate engraver of the Royal Academy in 1853, and academician in 1871.—His third son, **ARTHUR STOCKS**, born 1846, died 1889, gained some success as a painter in oil and water-colour.

**STODDARD, RICHARD HENRY**, American poet and journalist, was born at Hingham, Mass., on July 2, 1825. He went to New York when very young, and there he was employed for some time in an iron-foundry. He began about 1848 to write in prose and verse for periodicals, and ultimately devoted himself to literature. For about twenty years he was employed in the New York custom-house and dock department. Among his numerous writings are *Footprints* (1849), a volume of poems; *Songs of Summer* (1856); *The King's Bell* (1862). *The Book of the East* (1871), a collection of poems; *Memoir of E. A. Poe* (1875); *Poems* (1880, collected); *Life of Washington Irving* (1886); *The Lion's Cub* (1890), poems; and *Under the Evening Lamp* (1893), essays on Hogg, David Gray, Ebenezer Elliot, Edward Fitzgerald, Blake, Lord Houghton, &c. From 1860 till 1870 he was literary editor of the *New York World*, and since 1880 he has held a similar position on the *New York Mail and Express*. His wife, **ELIZABETH D. BARSTOW**, is known as a poet.

**STOKES, SIR GEORGE GABRIEL**, a distinguished writer on mathematical physics, son of a clergyman,

was born at Skreen, in county Sligo, on Aug. 13, 1819. He was educated in Dublin and at Bristol College, and afterwards entered Pembroke College, Cambridge, where he graduated as senior wrangler in 1841. He was elected a fellow of his college, and in 1849 was appointed to the Lucasian professorship of mathematics in the university. He became a fellow of the Royal Society in 1851, and in the following year he received its Rumford medal in recognition of certain investigations in optics. From 1854 till 1885 he was secretary, and in 1885–90 president of the society, and in 1869 he presided over the meeting of the British Association at Exeter. He was Burnett lecturer at Aberdeen in 1883–86, and Gifford lecturer at Edinburgh in 1890–92. He represented the University of Cambridge in the House of Commons in 1887–92. He has received honorary degrees from the Universities of Cambridge, Oxford, Edinburgh, Glasgow, Aberdeen, and Dublin, and several foreign countries have recognized his scientific work. He was created a baronet in 1889. His researches belong chiefly to the departments of hydrodynamics, elasticity, and especially physical optics, and are scattered through the publications of learned societies. His most important *Mathematical and Physical Papers* were collected in 1883–84 in three volumes. His Burnett lectures on light were published in 1887.

**STOKES, WHITLEY**, a distinguished Celtic scholar and writer on Indian law, eldest son of William Stokes, Regius professor of medicine in Dublin University, was born at Dublin in 1830. He was educated at Trinity College, Dublin, and was called to the bar at the Inner Temple in 1855. After practising for a time as an equity draftsman and conveyancer, he went to India in 1862. During 1863–64 he was reporter to the high court at Madras and acting administrator-general, and he then became successively secretary to the governor-general's legislative council and to the legislative department of the government of India. In 1877–82 he was law member of the governor-general's council, and during his official career in India he drafted the greater part of the present codes of civil and criminal procedure as well as numerous acts relating to property, trusts, &c. In 1879 he was president of the Indian Law commission. In 1868 he proposed a scheme for collecting and cataloguing the Sanskrit manuscripts preserved in India. His published works fall into two classes, those treating of legal, and those dealing with Celtic subjects. The former include: *Treatise on the Liens of Legal Practitioners* (1860); *On Powers of Attorney* (1861); *Hindu Law-Books* (1865); *The Indian Succession Act, with Commentary* (1865); *The Indian Companies' Act, with Notes* (1866); *The Older Statutes in Force in India, with Notes* (1874); and *The Anglo-Indian Codes* (two vols., 1877–88; supplements, 1889 and 1891). His Celtic editions and works include: *Irish Glosses* (1860); *Three Irish Glossaries* (1862); *The Play of the Sacrament* (1862); *The Passion, a Middle Cornish Poem* (1862); *The Creation of the World, a Cornish Mystery* (1863); *Three Middle Irish Homilies* (1871); *Goidelica* (1872); *The Life of S. Meriasek, a Cornish drama* (1872); *Middle-Breton Hours* (1876); *The Calendar of Oengus* (1880); *Togail Troi* (1881); *Saltair na Rann* (1883); *The Tripartite Life of St. Patrick* (1887), in the *Rolls Series*; *The Old Irish Glosses at Würzburg and Carlsruhe* (1887); *Lives of Saints from the Book of Lismore* (1889); *Urkeltscher Sprachschatz* (1894), with Prof. Bezzenberger; *The Martyrology of Gorman* (1895); *The Rennes Dindsenchas* (1896); *The Annals of Tigernach* (1897); *The Gaelic Marco*

Polo, Maundeville, and Fiersbras (1898); The Eulogy of St. Columba (1899); &c. He is joint-editor of *Irische Texte* and of the *Archiv für Celtische Lexicographie*. He is a C.S.I. and a C.I.E., and holds honorary degrees from Oxford, Edinburgh, and Dublin. He has also received honours from France and Germany.

**STOLBERG**, a town in Rhenish Prussia, on the Vicht, 7 miles east of Aix-la-Chapelle. Mining for coal, iron, lead, zinc, &c., is extensively carried on in the neighbourhood, and there are smelting-works, iron-foundries, rolling-mills, chemical-works, &c. It contains a very old castle. Pop. (1895), 13,532.

**STONE, FRANK**, English genre painter, was born at Manchester on August 22, 1800, and died at London on Nov. 18, 1859. He painted at first in water-colours, and was for long a member of the old Water-colour Society. His first important work in oil, the Legend of Montrose, was exhibited at the Academy in 1840. Among his subsequent works are: The First Appeal, The Last Appeal, Mated, The Course of True Love, The Gardener's Daughter. Most of his works have been engraved. He was elected A.R.A. in 1851.

**STONE, MARCUS, R.A.**, a painter of historical genre, the second son of Frank Stone, A.R.A., was born in London on July 4, 1840. He learned his art in his father's studio, and exhibited his first picture in 1858 in the Academy, of which he became an associate in 1877, being elected an academican in 1887. In his earlier years he illustrated various works by Dickens, Trollope, and others. Among his better-known pictures are: Claudio accuses Hero (1861); On the Road from Waterloo to Paris (1863); Stealing the Keys (1866); Henry VIII. and Anne Boleyn (1870); Sain et Sauf (1875); Il y en a toujours un Autre (1882); A Gambler's Wife (1885); In Love (1888); The First Love Letter (1889); Two's Company, Three's None (1892); and A Honeymoon (1893). Most of his works have been engraved.

**STONEHOUSE**, or **EAST STONEHOUSE**, a western suburb of Plymouth, lying between the latter and Devonport, and separated from Devonport by the Stonehouse Pool. It has extensive barracks, the Royal Naval Hospital, and the Victualling Office.

**STONE-LILY**, a popular name of the encrinites. See **ECHINODERMATA**.

**STONE-PINE**, a tree of the genus *Pinus*, the *P. Pinea*, common in the south of Italy. It is often introduced into pictures. See **PINE**.

**STONE-POLOVER**, a large species of plover, the *Edicnemus crepitans*. See **THICK-KNEE**.

**STONYHURST COLLEGE**, an English Roman Catholic educational institution 10 miles north of Blackburn, Lancashire. The college was originally founded at St. Omer in Flanders in 1592, but in 1794 it was transferred to England. It is affiliated to the University of London, and provides a school course of instruction for boys and a university course for young men. Attached to it is a good observatory, an excellent library, museums, &c. Several well-known men have been educated here. The series of Stonyhurst Philosophical Manuals by the Jesuit professors in the philosophical department of the college represents an able and notable attempt to revive the scholastic philosophy as expounded by St. Thomas, and adapt it to modern thought.

**STORM-SIGNAL**, a cone and drum used at seaports and coast-guard stations to indicate the approach of a storm. The cone exhibited alone, with its apex down, portends a south gale; with its apex up, a north gale. The cone with the apex down and the drum over it portends dangerous winds from the south; with the apex up and the

drum under, dangerous winds from the north. The United States has a more elaborate system of meteorological signals.

**STORY, JOSEPH, LL.D.**, American lawyer, was born at Marblehead, Massachusetts, on Sept. 18, 1779, and died at Cambridge in the same state on Sept. 10, 1845. He was educated at Harvard College, where he graduated in 1798, and he afterwards studied law. In 1808 he entered congress, in 1810 became speaker of the Massachusetts state legislature, and soon after was appointed a judge of the United States Supreme Court. In 1829 he became first Dane professor of law at Harvard, a position which he held for the rest of his life. His law works include a number of special treatises, commentaries, and judgments, and a collection of his miscellaneous writings was published in 1852. Among the legal works are: On the Law of Bailments (1832); On the Constitution of the United States (1833); On Equity Jurisprudence, as administered in England and America (1835); On the Law of Agency (1839) On the Law of Partnership (1841); On the Law of Bills of Exchange (1843); and others.—His son, **WILLIAM WETMORE STORY**, born on Feb. 19, 1819, in Salem, Mass., studied law, and published several law-books, but gave up the legal profession. He resided long in Rome, and was both a sculptor and a poet. He wrote a life of his father (1851) and edited his writings. He died at Vallombrosa on Oct. 7, 1895.

**STOURPORT**, a town of England, in Worcestershire, on the left bank of the Severn, where it is joined by the river Stour and the Staffordshire and Worcestershire Canal, 4 miles south-west of Kidderminster. Iron-works, carpet-works, tanning, &c., give employment to the inhabitants. Pop. (1891), 4865; (1901), 4529.

**STOWE, MRS. HARRIET ELIZABETH**, American novelist, daughter of the Rev. Lyman Beecher and sister of Rev. Henry Ward Beecher, was born at Litchfield, Connecticut, on June 14, 1812. She became associated with her sister Catherine in teaching a school at Hartford, and afterwards removed to Cincinnati, where she married the Rev. Calvin E. Stowe, a theological professor, in 1836. She wrote several tales and sketches, collected in 1849 under the title of *The Mayflower, or Sketches of the Descendants of the Pilgrims*; and contributed to the *National Era*, a newspaper published at Washington, the serial story of *Uncle Tom's Cabin*. This famous work was issued in book-form in 1852, when it achieved an enormous success both in the United States and Europe. It has been translated into very many languages, and the influence it exerted in the formation of anti-slavery sentiment can hardly be over-estimated. Among her other numerous writings are: *Key to Uncle Tom's Cabin* (1853); *Sunny Memories of Foreign Lands* (1854); *Dred, a Tale of the Dismal Swamp*, afterwards known as *Nina Gordon* (1859); *The Minister's Wooing* (1859); and *Lady Byron Vindicated* (1870). The last-named work was a reply to various criticisms of an article on *The True Story of Lady Byron's Life*, contributed by her in 1869 to the *Atlantic Monthly* and *Macmillan's Magazine*. She died at Hartford, Connecticut, on July 1, 1896.

**STRADIVARI (STRADIVARIUS), ANTONIO**, a celebrated violin-maker, was born at Cremona, Italy, about 1649, and died in 1737. He was a pupil of Nicolo Amati, in whose employment he remained until about 1679, when he began making on his own account. It was he who settled the typical pattern of the Cremona violin, and his instruments, for tone and finish, have never yet been excelled. His improvements consisted chiefly in lowering the

height of the arch of the belly, in making the four corner-blocks more massive, in giving greater curvature to the middle ribs, in altering the setting of the sound-holes, and in making the scroll more massive and prominent. He reached his greatest perfection in his art about 1714. He also made many other kinds of musical instruments, but it is on his violins of all kinds that his fame rests.

**STRAIN.** See **STRESS AND STRAIN**.

**STRASS**, a variety of flint-glass, but containing more lead, and, in some cases, a smaller proportion of borax, used in the manufacture of artificial gems of the better class. See **GLASS, GEMS**.

**STRATFORD DE REDCLIFFE.** See **CANNING (STRATFORD)**.

**STRATUM**, in geology, a layer of any deposited substance, as sand, clay, limestone, &c., which has been originally spread out over a certain surface by the action of water, or in some cases by wind; especially such a layer when forming one of a number superposed and forming a mass of rock. When strata do not lie horizontally, but are inclined, they are said to *dip* towards some point of the compass, and the angle they make with the horizon is called the *angle of dip* or inclination. When strata protrude above the surface, or appear uncovered, they are said to *crop out*. They are said to be *conformable* when their planes are parallel, whatever their dip may be; and *unconformable* when there is a want of parallelism between the strata. See **GEOLOGY**.

**STRAUSS, JOHANN**, German composer of dance music, was born at Vienna on March 14, 1804. His musical talent revealed itself early, and by the assistance of a benefactor he was taught to play the violin. He became a successful orchestral conductor, and visited the chief cities of Germany, France, Britain, and Austria, in all of which he was well received. He died at Vienna on Sept. 5, 1849. He composed over 150 waltzes, besides marches (including the *Radetzky*), galops, polkas, quadrilles, &c.—His eldest son, **JOHANN**, born in Vienna on Oct. 25, 1825, has also toured through Europe at the head of an orchestra, and has been long at the head of a famous orchestra in Vienna. He has written over 400 waltzes, many of them—including *An der schönen blauen Donau* (*Blue Danube*)—world-famous, and is the author of several successful operettas, such as *Indigo und die vierzig Räuber* (1871); *Der Karneval in Rom* (1873); *Die Fledermaus* (1874); *Cagliostro* (1875); *Prinz Methusalem* (1877); *Blindeküh* (1878); *Das Spitzentuch der Königin* (1880); *Der lustige Krieg* (1881); *Eine Nacht in Venedig* (1883); *Der Zigeunerbaron* (1885); *Simplicius* (1887); *Ritter Pasman* (1892); *Jabuka* (1894); *Waldmeister* (1896); and *Die Göttin der Vernunft* (1897).—Two other sons, **JOSEPH** (born 1827, died 1870) and **EDWARD** (born 1835), have also distinguished themselves as composers and conductors.

**STRAW PLAIT**, straw plaited or braided into strips or tissues of some size for making hats, bags, ornaments, &c. In the manufacture of straw hats the straw must be of a certain length between the knots, and must not be brittle; and these qualities are found most frequently in the wheat grown in Tuscany, where the well-known Leghorn hats are made. When the grain is still green the straw is pulled up by the roots, dried in the sun, bleached by means of sulphureous fumes, split by a machine, and then plaited into hats by women and young children as a domestic industry. Certain kinds of wheat cultivated around Luton in Bedfordshire were found suitable for plaiting, from which cause it became the centre of the straw-plait industry in England. Straw plait is now made in various other countries, including Switzerland, Holland, and Bel-

gium. Great quantities of braid are now exported from China, partly to the United States, where the making of hats, &c., from imported plait is now an extensive industry.

**STREET, GEORGE EDMUND**, a distinguished architect, was born at Woodford, Essex, on June 20, 1824. He was educated in Mitcham and Camberwell, and received part of his professional training under Sir G. G. Scott, and like him held the Gothic style in highest favour, the numerous lectures and papers which he wrote on architecture being all directed to illustrate the history and principles, and promote the progress, of that style. His principal literary works are: *The Brick and Marble Architecture of North Italy in the Middle Ages* (1855); *Some Account of Gothic Architecture in Spain* (1865); and the article on Gothic Architecture in the *Encyclopædia Britannica* (9th edition). He was for many years engaged in the work of erecting and restoring churches and other ecclesiastical buildings all over the country. In 1868 he was appointed architect of the new Courts of Justice in the Strand, London, after a competition in which were engaged the most famous architects of the day, including Sir G. G. Scott, E. M. Barry, &c. This gigantic undertaking was not quite completed at his death, which occurred on the 18th December, 1881. In 1866 he was elected an Associate of the Royal Academy, and in 1871 became a Royal Academician. In the last year of his life he was appointed professor of architecture at the Royal Academy. See a memoir by his son, A. E. Street (1888).

**STRETFORD**, a town of England, in Lancashire, 4 miles south-west of Manchester. Besides several churches and chapels, it has a public hall, public offices, a free library, a blind asylum, a school for the deaf and dumb, botanical gardens, &c. It gives name to a parliamentary division of the county. Pop. of town (1891), 21,751; (1901), 30,346; of parl. div. (1901), 96,174.

**STRICTURE**, a contraction of a tube, duct, or orifice; for instance, of any part of the alimentary canal or of the urinary passages. This disease usually affects the urethra, and is treated by dieting and dilatation of the passage by means of catheters.

**STRING-HALT**, a defect in a horse consisting in a sudden twitching of the hinder leg or legs, or an involuntary or convulsive motion of the muscles that extend or bend the hough. Though it does not impair the usefulness of the animal it lessens its value, as to some extent spoiling its appearance. The word is written sometimes *spring-halt*.

**STROPHANTHIN**, a crystalline glucoside with a strongly bitter taste, obtained from the seeds of *Strophanthus hispidus*, a plant belonging to the natural order Apocynaceæ, and a native of Africa. It is readily soluble in water and alcohol. Strophanthin is a muscle-poison, and increases the contractile power of the muscles. It has lately been used with great advantage as a tonic in heart-disease. It strengthens the heart-beat and reduces its frequency. The natives of Africa use it as an arrow poison.

**STRUTHIONIDÆ**, a family of terrestrial birds incapable of flight, the wings being, in the majority of instances, merely rudimentary, but having long and strong legs, which enable them to run with great rapidity. This family includes the ostrich, casowary, emu, &c., and is equivalent to the Brevipennes of Cuvier and the Ratitæ of Huxley. See **OSTRICH, &c.**

**STRY**, or **STRI**, a town of Austria, in Galicia, on a river of the same name, a tributary of the Dniester. It was the scene of a great conflagration in April, 1866, which destroyed over 600 houses and

most of the public buildings. The chief manufactures are leather goods and matches. Pop. (1890), 16,515.

**STRYCHNOS**, a genus of plants of the natural order Loganiaceae, composed of trees or shrubs which are found principally in the tropical parts of Asia and America. Among the species are *S. nux-vomica*, nux-vomica, poison-nut, or ratsbane; *S. potatorum*, or clearing-nut; *S. Ignatii*, or St. Ignatius' bean; *S. colubrina*, or snakewood; *S. toxifera*, woorali or poison-plant of Guiana. See **STREYCHNINE**, **NUX-VOMICA**, &c.

**STRYPE**, **REV. JOHN**, ecclesiastical historian, was born in London on Nov. 1, 1643, and educated at St. Paul's School, and Jesus College and Catharine Hall, Cambridge, where he graduated B.A. in 1665. In 1670 he became vicar of Leyton, Essex, and remained there till within a few years of his death. He published nothing till after he was fifty, and his works consist for the most part of transcriptions of curious and valuable papers, which he brought to light for the first time. The chief of them are *Memorials of Cranmer* (1694); followed by the *Lives of Sir Thomas Smith* (1698); *Bishop Aylmer* (1701); *Archbishop Parker* (1711), and *Archbishop Whitgift* (1718); *Annals of the Reformation in England* (1709); and *Ecclesiastical Memorials* (three vols., 1721). These, though written in a wearisome style and not always perfectly trustworthy, are of very great value to the student of English history. He died at Hackney on Dec. 11, 1737.

**STUART**, **JOHN M'DOULL**, a celebrated Australian explorer, was born at Dysart, Fifeshire, Scotland, on Sept. 7, 1818. He was educated at Edinburgh, and for some time engaged in business. In 1838 he set out for Australia, where he became connected with the government survey of South Australia. In 1844-46 he accompanied as draughtsman Sturt's expedition into the interior, and in 1858 he headed the first of his own expeditions. Little resulted from it, but in the following year he explored much of the country about Lake Torrens. In 1860 he penetrated into the centre of Australia, and named Mount Stuart, and in 1862 he achieved the difficult task of crossing the Australian continent near the centre from south to north and back again. He died in London on June 5, 1866. His exploring work had completely ruined his health. He wrote *Explorations in Australia*, edited and published in 1864 by W. Hardman, London.

**STUBBS**, **WILLIAM**, English historian and bishop, son of a solicitor, was born at Knaresborough on June 21, 1825. He was educated at the grammar-school of Ripon, and proceeded to Christ Church, Oxford, where he graduated in 1848 with a first in classics. In that year also he was ordained and elected to a fellowship of Trinity College, and two years later he was appointed vicar of Navestock, in Essex. He became librarian to Archbishop Longley at Lambeth in 1862, and during the six years 1860-66 he was inspector of schools in the diocese of Rochester. By this time he had gained a reputation for historical scholarship, and in 1866 he was appointed Regius professor of modern history at Oxford. He was presented to the rectory of Cholderton, in Wiltshire, in 1875, became a canon residentiary of St. Paul's in 1879, and in 1884 he was promoted to the bishopric of Chester, from which in 1889 he was translated to the see of Oxford. He remained bishop of Oxford till his death, which occurred on April 22, 1901. He was elected ordinary fellow of Oriel College in 1867, and honorary fellow in 1888, honorary fellow of Balliol College in 1876, honorary student of Christ Church in 1878, curator of the Bodleian Library and a delegate of the

Clarendon Press in 1868, and a member of the Hebdomadal Council in 1872. Oxford, Cambridge, Edinburgh, and Dublin conferred honorary degrees upon him, and he was a member of many learned societies, both British and foreign. Bishop Stubbs was perhaps the foremost mediæval historian of his time. His work shows remarkable industry and the most painstaking accuracy, and several of his books are likely to remain authoritative for a long time. Stubbs's reputation rests mainly upon his great Constitutional History of England in its Origin and Development (three vols., 1874, 1875, 1878), which ends with 1485, the date when Hallam's work begins. An important companion work is the earlier Select Charters and other Illustrations of English Constitutional History, from the Earliest Period to the Reign of Edward I. (1870). Two of his works treat of the ecclesiastical history of England, namely, *Registrum Sacrum Anglicanum* (1858), on episcopal succession, and *Councils and Ecclesiastical Documents of Great Britain and Ireland* (three vols., 1869-78), the latter prepared in collaboration with Rev. A. W. Haddan. He was one of the most learned and industrious editors of works in the Rolls Series, his contributions, always containing exhaustive and valuable introductions, being: *Chronicles and Memorials of the Reign of Richard I.* (two vols., 1864-65); *Gesta Henrici Secundi*, ascribed to Benedict of Peterborough (two vols., 1867); *Roger of Hoveden's Chronicle* (four vols., 1868-71); *Historical Collections of Walter of Coventry* (two vols., 1872-73); *Memorials of St. Dunstan* (1874); *Ralph de Diceto's Opera Historica* (two vols., 1876); *The Historical Works of Gervase of Canterbury* (two vols., 1879-80); *Chronicles of the Reigns of Edward I. and Edward II.* (two vols., 1882-83); and *William of Malmesbury's De Gestis et Historia Novella* (two vols., 1887-89). His other works are the following: *Hymnale secundum Usum Sarum* (1850); *Tractatus de Santa Cruce de Waltham* (1860); *The Early Plantagenets* (1877), in the series of Epochs of English History; and *Seventeen Lectures on the Study of Mediæval and Modern History* (1886); besides an English edition (1863) of Mosheim's *Institutes of Church History*.

**STURT**, **CHARLES**, Australian explorer, was born in the presidency of Bengal, India, on April 28, 1795. Educated in Cheshire and at Harrow, he joined the army in 1813 as ensign in the 89th Regiment. In the following year he served in France and Canada, and from 1819 till 1828 he was occupied in suppressing riots in Ireland. Appointed lieutenant in the earlier part of 1825, and captain in December of that year, he went to Sydney in 1827, where he became military and private secretary to Sir Ralph Darling, governor of New South Wales. Between 1828 and 1830 he headed two government expeditions towards the interior, in the course of which he discovered the Murray and the Darling rivers, and practically solved the problem of the hydrography of the south-eastern portion of Australia. Like M'Doull Stuart, he suffered greatly in general health and in eyesight, and for a time he returned to England. In 1838 he again explored the rivers of New South Wales, but in the following year he settled at Adelaide, where he was soon appointed assistant commissioner of lands. In 1842 he became registrar-general, and two years later he headed an expedition to the interior, which was sent out at his own request. After suffering greatly from want of water a portion of the party penetrated to Cooper's Creek, but they were baffled in their efforts to proceed farther north. The total distance covered in this expedition was about 3500 miles, and the time occupied was nineteen months. He was appointed

colonial treasurer in 1845, and from 1849 till 1851 he held the office of colonial secretary. From 1853 till his death on June 16, 1869, he lived at Cheltenham, England. In 1847 he received the founder's medal of the Royal Geographical Society, and at the time of his death he was about to be created K.C.M.G. He published accounts of his journeys in his Journals (1833, two vols.) and Narrative of an Expedition into Central Australia, 1844-46, with a Notice of the Province of South Australia in 1847 (two vols., 1849).

**STYRAX**, a genus of plants of the natural order *Styracaceae*, of which it is the type. The species, about sixty in number, are elegant trees and shrubs, with entire leaves and white or cream-coloured racemose flowers. They are principally natives of America and Asia; one is found in Europe, and one in Africa. *S. officinalis*, also called storax, is a native of Syria, Italy, and most parts of the Levant. It yields the storax of commerce (which see). *S. Benzoïn* (gum-benjamin tree), also known as *Benzoin officinale*, is a native of Sumatra and Java. It yields the gum benzoïn of commerce. (See *Benzoin*.) The hardy species of *Styrax* are well adapted for shrubberies, on account of their foliage and handsome flowers.

**SUAHELI**, a name given to the inhabitants of the Zanzibar coast of East Africa and the adjacent islands, a people of mixed Arabic and native African origin. They form the most important part of the subjects of the Sultan of Zanzibar, and their language is the common medium of communication in East Africa.

**SUCHOW**. See *Soo-CHOW-FOO*.

**SUFFRAGE**, the right to vote for any purpose, but more especially the right of a person to vote in the election of his political representative. Many writers advocate the universal extension of this right, but in Britain and most European countries it is limited by a household or other qualification. It is generally held by leading politicians that the extension of the suffrage should proceed gradually with the advance of education. *Female suffrage* means the extension of the right of voting to women. A few countries or states, such as Australia and New Zealand, have granted the suffrage in national affairs to women, and many more, including the United Kingdom, allow women to vote for certain local purposes. *Manhood suffrage* means the granting of full electoral privileges to all males who have attained a certain age and are not physically or morally disqualified.

**SUKKUR**, a town of Bombay Presidency, India, in the Shikarpur district of Sindh, on the right bank of the Indus, opposite Rohri. It contains the usual public offices, with a civil hospital, dispensary, and an Anglo-vernacular school. It has a considerable local and transit trade, but no special manufacturing industries. Pop. (1891), 29,302; (1901), 31,316.

**SULLIVAN, SIR ARTHUR SKYMOUR**, English composer, was born in London on May 13, 1842. He was of Irish descent, and his father at the time of his birth was a band-master and professor of the clarinet at Kneller Hall, the training-school for British military bands. He received his earliest training in music at the Chapel Royal, where he became a chorister at an early age, and in 1856, at the age of fourteen, he gained the Mendelssohn Scholarship. He then entered the Royal Academy of Music, where he studied for two years under Mr. (afterwards Sir William) Sterndale Bennett and Mr. (afterwards Sir John) Goss. The following three years were devoted to study in the Conservatory of Music at Leipzig, where he came into contact with

many able teachers and accomplished instrumentalists. Returning to England in 1861, he at once gained considerable success with his music to Shakspeare's *Tempest*, which was produced in 1862 at the Crystal Palace. His next work of note was a cantata entitled *Kenilworth*, performed at the Birmingham Festival in 1864; and in 1866 a *Symphony in E* (his only one) was produced at the Crystal Palace. In 1866, also, his overture *In Memoriam* was first played at Norwich; and there followed in steady succession the overture *Marmion* (1867), first produced by the Philharmonic Society; an oratorio entitled *The Prodigal Son* (1869), at Worcester; the overture *Di Ballo* (1870), at Birmingham; and *On Shore and Sea* (1871), a cantata. He composed a *Te Deum* in 1872 to commemorate the recovery of the Prince of Wales, and in 1873 his oratorio *The Light of the World* was produced at Birmingham. His well-known sacred musical drama *The Martyr of Antioch* was first performed at the Leeds Festival of 1880; and the dramatic cantata of the *Golden Legend*, which many regard as his best work, was introduced at the festival in the same town in 1886. In 1866 he composed the comic operetta *Cox and Box*, written by Mr. (now Sir) F. C. Burnand, afterwards editor of *Punch*, and in the following year a similar work entitled *The Contrabandista* was produced. In 1871 he collaborated with Mr. W. S. Gilbert in the production of *Thespia*, which may be regarded as the first of the long and brilliant series of comic operas first put on the stage at the Savoy Theatre. The second of the series, *Trial by Jury* (1875), marked a distinct advance, and was followed two years later by the still more successful one entitled *The Sorcerer*. The reputation of both composer and librettist was enormously enhanced by *H.M.S. Pinafore* (1878), which had an uninterrupted run of seven hundred nights in London and became immediately popular everywhere. It was followed by the *Pirates of Penzance* (1880); *Patience* (1881); *Iolanthe* (1882); *Princess Ida* (1884); *The Mikado* (1885), one of the best and most popular of the series; *Ruddigore* (1887), not very successful; *The Yeomen of the Guard* (1888); and the *Gondoliers* (1889). After the production of *The Gondoliers* the partnership of the two brilliant collaborators was dissolved owing to some unfortunate disagreement, and in consequence Sir Arthur composed no more comic operas till 1892, when *Haddon Hall*, with libretto by Sydney Grundy, was produced. In *Utopia, Limited* (1893) and the *Grand Duke* (1896) Mr. Gilbert and Sir Arthur were again united, but neither rose to the level of their former triumphs. In *Ivanhoe*, produced in 1891, he made a splendid effort towards the creation of a national English school of serious opera, but the inherent merits of the work did not meet with the success they deserved. Among Sir Arthur's other works are: *The Chieftain* (1894), an enlarged form of the *Contrabandista*; *The Beauty Stone* (1898), with libretto by A. W. Pinero and Comyns Carr; *The Rose of Persia* (1899); *The Emerald Isle* (1901), completed by E. German; several well-known hymn tunes, anthems, and other sacred pieces; incidental music to the *Merry Wives of Windsor*, *The Merchant of Venice*, *Henry VIII.*, and *Macbeth*; several other orchestral pieces; two ballets; pianoforte compositions; violoncello concertos; and many popular songs, notably *The Lost Chord*. He was knighted in 1883, and both Cambridge and Oxford conferred upon him the honorary degree of Doctor of Music. He was principal of the National Training School of Music from its foundation in 1876 to 1881, and he conducted the Leeds Triennial Festival from 1880 till 1898 inclusive. He died of failure of the

heart in London on Nov. 22, 1900. Sir Arthur Sullivan was the most distinguished representative of English music during the last quarter of the nineteenth century. Though he had studied the great German masters, and was thoroughly conversant with their methods, his whole work is distinctively English. He did much to raise English music in the estimation of foreign critics and foreign audiences. There is a *Life* by A. F. Lawrence (1899).

**SULLY, JAMES**, writer on psychological and philosophical subjects, son of a colliery proprietor, was born at Bridgewater, Somerset, on March 3, 1842. He was educated in the Independent College at Taunton and in Regent's Park College, London, and in 1868 he obtained the degree of M.A. and a gold medal from the University of London. He afterwards studied at the Universities of Göttingen and Berlin, and in 1871 began to contribute to newspapers and reviews. Since 1892 he has been Grote professor of the philosophy of mind and logic in University College, London, and he also holds the post of lecturer on education at the College of Preceptors. He was a contributor to the ninth edition of the *Encyclopædia Britannica*, his articles including *Evolution*, *Herder*, *Lewes*, &c. His separate publications are: *Sensation and Intuition* (1874); *Pessimism, A History and a Criticism* (1877), containing acute criticism of Schopenhauer and Von Hartmann; *Illusions* (1881), in the *International Scientific Series*; *Outlines of Psychology*, with especial reference to the *Theory of Education* (1884); *The Teacher's Handbook of Psychology* (1886), based upon the preceding work; *The Human Mind* (1892); *Studies of Childhood* (1895); and *Children's Ways* (1897), a smaller work extracted from the foregoing. Prof. Sully is honorary LL.D. of St. Andrews University. He belongs to the sensationalist school in psychology.

**SULPHUROUS OXIDE**, or **SULPHUR DIOXIDE** (SO<sub>2</sub>). See **SULPHUR**.

**SULPICIAN**, a Roman Catholic congregation of missionary priests founded in 1642 at Paris by the Abbé Ollier. They have a number of houses in Europe and America, and are chiefly engaged in training young men for the priesthood. They are called Sulpicians from the parish of St. Sulpice, where the congregation was first organized.

**SULTANPUR**, a district of India, in the Fyzabad division of Oudh; area, 1710 square miles. Its chief river is the Gumti. More than half the total area is under cultivation, the chief crops being wheat and rice. Pop. (1891), 1,075,851.—The town **SULTANPUR**, administrative head-quarters of the district, contains the usual public buildings, and no features of special note. It was razed to the ground during the operations connected with the suppression of the mutiny. Pop. (1891), 8751.

**SUMAO**. See **SUMAO** in **SUPP.**

**SUMBA**, same as **SANDALWOOD ISLAND** (which see).

**SUMBAL**, or **SUMBUL**, an Eastern name for the root of an umbelliferous plant, *Euryangium sumbul*. It contains a strongly odorous principle, like that of musk, and is regarded as an antispasmodic and stimulating tonic. The root was used in medicine before the plant to which it belonged was known; but in 1869 Kaufmann, a Russian explorer, found it growing in Russian Turkestan and introduced it into the Moscow Botanic Gardens. It is now usually called *Ferula sumbul*. Sumbul is also an Eastern (Arabic) name of spikenard (which see).

**SUMMARY PROCEEDING**, in law, said of a form of trial in which the ancient established course of legal proceedings is disregarded, especially in the

matter of trial by jury. In no case can a party be tried summarily unless when such proceedings are authorized by legislative authority, as in a committal for contempt of court, the conviction of a person by justices of the peace, &c.

**SUMNER, JOHN BRID, D.D.**, Archbishop of Canterbury, son of a clergyman, was born at Kenilworth, Warwickshire, on Feb. 26, 1780, and educated at Eton and King's College, Cambridge, where he took high honours. He entered the church, and became rector of Mapledurham, in Oxfordshire. In 1820 he was made canon of Durham, in 1828 bishop of Chester, and in 1848 archbishop of Canterbury. Though holding evangelical views, he showed throughout his primacy a generous tolerance of the opinions of those who differed from him. He died at Addington, near London, on Sept. 6, 1862. His works include *A Treatise on the Records of the Creation and the Moral Attributes of the Creator* (1816); *The Evidence of Christianity derived from its Nature and Reception* (1824); *Lectures on the Gospels and Epistles* (1831-40); and *Practical Reflections* (1859).

**SURBITON**, a town or urban district of England, in Surrey, a short distance to the south of Kingston, and on the right bank of the Thames, opposite the grounds of Hampton Court. Like Kingston-upon-Thames it is rapidly increasing. Pop. (1891), 12,178; (1901), 15,019.

**SURREY, HENRY HOWARD, EARL OF**, English poet, born about 1516, was the grandson of the Earl of Surrey who was the victor at Flodden, and who, as a reward for his services, was created Duke of Norfolk. He succeeded to the courtesy title of Earl of Surrey when his father became third Duke of Norfolk of the Howard house in 1524. The Howards held an eminent position at the court of Henry VIII., and Surrey's cousin, Catharine Howard, became the king's fifth wife. Surrey became companion to the Duke of Richmond, a natural son of Henry VIII., and in 1533 he travelled with him to the French court. He took part in the suppression of the Pilgrimage of Grace in 1536, and in the following year he was imprisoned for striking a courtier who had repeated a rumour of his sympathy with the rebels. He served in the army on the Continent, and in 1545 was appointed commander of Boulogne, but he was shortly afterwards defeated by the French and superseded in his command. Shortly before Henry's death Surrey and his father were suspected of aiming at the throne, and were arrested and lodged in the Tower, and Surrey was tried, condemned, and executed on Jan. 21, 1547. In 1538 there was published his translation of the second and fourth books of Virgil's *Æneid*, the first attempt at blank verse in English. He also wrote many sonnets after the Italian model. See *Deux Gentilshommes-Poètes de la cour de Henry VIII* by Edmund Bapst (1891).

**SUSA** (ancient *Hadrumetum*), a seaport of Tunisia, on the Gulf of Hamâma, 45 miles from Kairwan. It has a rapidly-increasing commerce, mainly carried on with Italy, the chief exports being oil, grain, sansa (olive refuse), and esparto. The town has outgrown its ancient walls. It is connected by a tramway with the holy city of Kairwan. Pop. 10,000.

**SUTTON**, a town of England, in Surrey, 4 miles north-east of Epsom, containing an old church, modern churches and chapels, the South Metropolitan schools for paupers, &c. It is a growing residential place. Pop. (1891), 13,977; (1901), 17,224.

**SUTTON COLDFIELD**, an ancient town, and now a municipal borough of England, in Warwickshire, 7 miles north-east of Birmingham. It has

been much improved of late years and is now a favourite place of residence with the business people of Birmingham, Walsall, and other towns. There is a fine park, a handsome town-hall, and other important buildings. Pop. (1891), 8685; (1901), 14,264.

**SUTTON-IN-ASHFIELD**, an ancient market-town of England, in Nottinghamshire, 3 miles south-west of Mansfield. There are manufactures of hosiery and chemical manures, and in the vicinity are collieries, lime-works, &c. Pop. (1891), 10,562; (1901), 14,862.

**SUVA**, the capital (since 1880) of the British crown colony of the Fiji Islands. It is situated on the south coast of Viti Levu, the largest island of the group, 1770 miles from Sydney, 1140 from Auckland, 2780 from Honolulu, and 5215 from Vancouver, and it has a good harbour. Among the buildings and institutions of the town are the government buildings, three churches, four hotels, a mechanics' institute with library, a post-office, jail, lunatic asylum, hospital, many stores and warehouses, &c. Pop. in 1901 (whites), 1073.

**SUWARROW** (or **SUVAROF**) ISLANDS, a group of three low wooded islands in the Pacific, about 450 miles N.N.W. of Cook or Hervey Islands, and about the same distance E. of Samoa. They were annexed to Britain in 1889.

**SWADLINCOTE**, a town of England, in Derbyshire, about half-way between Burton-on-Trent and Ashley-de-la-Zouch, a place of recent upgrowth, with a town-hall, modern churches and chapels, &c. It is noted for the manufacture of earthenware, including sanitary and fine goods, fire-bricks, &c.; and there are also collieries. Pop. (1891), 13,889; (1901), 18,014.

**SWAFFHAM**, a market-town of England, in Norfolk, 25 miles west of Norwich, with a fine fifteenth-century church, town-hall, market-cross, &c. Pop. (1891), 3636; (1901), 3371.

**SWAHILI**. See **SUAHILI** in **SUPP.**

**SWAKOPMUND**, a station in German South-west Africa, situated at the mouth of the Swakop River, which bounds the Walvisch Bay settlement on the north. See **SOUTH-WEST AFRICA** in **SUPP.**

**SWAN**, **JOSEPH WILSON**, inventor, was born in Sunderland on Oct. 31, 1828, and educated near his native town. He invented the carbon process of making autotypes, and with Mr. Woodbury introduced Woodburytype. (See **PHOTOGRAPHY**.) To him also is due the invention of the dry plate, which has revolutionized photography. His name is, however, best known in connection with a form of incandescent electric lamp devised by him, which was the earliest in date of the many electric lamps now in use. His other inventions include a miner's electric safety-lamp, and various improvements in photo-mechanical printing and electro-metallurgical deposition. He is a Knight of the Legion of Honour, vice-president of the Royal Photographic Society, and in 1898-99 he was president of the Institution of Electrical Engineers.

**SWAN RIVER**, a river in Western Australia, which colony was originally known as the 'Swan River Settlement'. Perth, the capital of the colony, is on the Swan River, and Fremantle is at its mouth. The length of the river is about 150 miles.

**SWAT**, a mountainous territory on the extreme north-west of British India, included in the North-west Frontier Province, and named from a river which flows through it. The territory is bounded by Bajaur on the west, Chitral on the north, and the Peshawar division on the south. The river rises on the southern slope of the mountains bounding Chitral on the south, and flows southwards parallel to

the Indus to join the Cabul River a short distance north-east of Peshawar. Thana and Aladand are towns on its banks in the Swat district.

**SWATOW**, a port of China, in the province of Kwang-tung, at the mouth of the Han River. It is entirely of modern origin, being built on ground recently recovered from the sea. It was opened to foreign commerce in 1869. The chief trade is with Hong-Kong. The principal exports are sugar, tobacco, native cloth, grass-cloth, ground-nuts, joss-paper, oranges, tea, &c.; and the imports comprise opium, cotton piece-goods and yarn, woollens, coal, kerosene-oil, rice, &c. The total annual trade is now valued at nearly £7,000,000. Swatow has also manufactures of bean-cake and sugar-refining. Pop. 31,000.

**SWEATING SYSTEM**, any system according to which work-people are overworked and poorly paid, especially the system by which sub-contractors undertake to do work in their own houses or small workshops, and employ others to do it, making a profit for themselves by the difference between the contract prices and the wages they pay their assistants. The object of the sub-contractor or sweater being to secure as large a margin of profit as possible, the tendency of the system is to grind the workers down to the lowest possible limit. Excessive hours of labour, unhealthy conditions, and a great extension of the employment of women and children where it is least advisable, are among the other evils attendant on the system. The tailoring trade gives the greatest scope for the operations of the sweater. A report to the Board of Trade on the Sweating System in the east end of London, prepared by Mr. John Burnett, the labour correspondent of the Board, was published in Dec. 1887, and a committee of the Lords was subsequently appointed to inquire into the sweating system in this portion of London. The scope of the commission was afterwards extended, and the localities investigated comprised London, Woolwich, Chatham, Sheffield, Newcastle, Leeds, Glasgow, Edinburgh, Liverpool, Manchester, Birmingham, &c. The report of this commission (1890) is of great value to the student of economics and social conditions, and it has led to various legislative changes directed against the system.

**SWEET-BRIAR**, or **SWEET-BRIER** (*Rosa rubiginosa*), a species of rose, a native of Britain, which grows wild, but is often planted in hedges and gardens on account of the sweet balsamic smell of its small leaves and flowers. Many varieties are distinguished, of which some half-dozen are found wild in Britain. It is also called the *eglantine*.

**SWETE**, **HENRY BARCLAY**, biblical scholar, was born on March 14, 1835, at Bristol, where his father was a clergyman. He was educated at King's College, London, and Gonville and Caius College, Cambridge, where he gained several prizes, and graduated in 1858. Ordained deacon in that year, he became dean, tutor, and theological lecturer in his college in 1869, holding these posts till his appointment as rector of Ashdon, Essex, in 1877. He was professor of pastoral theology in King's College, London, from 1882 till 1890, and examining chaplain to the Bishop of St. Albans from 1881 till 1890; and since 1890 he has been Regius professor of divinity at Cambridge. His published works include *Early History of the Doctrine of the Holy Spirit* (1873); *History of the Doctrine of the Procession of the Holy Spirit* (1876); *Commentary of Theodore of Mopsuestia on the Minor Epistles of Saint Paul* (1880-82); *The Old Testament in Greek, according to the Septuagint* (three vols., 1887-94; new edition, 1895-99); *The Akhmim Fragment of the Apocryphal Gospel of Saint Peter* (1893); *The*

*Apostles' Creed in Relation to Primitive Christianity* (1894; 3rd ed., 1899); *Faith in Relation to Creed, Thought, and Life* (1895); *Church Services and Service-Books before the Reformation* (1896); *The Gospel According to Saint Mark, and the Greek Text, with Introduction, Notes, and Indices* (1898); and *An Introduction to the Old Testament in Greek* (1900). He also contributed to *Smith and Wace's Dictionary of Christian Biography* and to *Hastings' Dictionary of the Bible*.

SWINBURNE, ALGERNON CHARLES, English poet, son of Admiral Charles Henry Swinburne by a daughter of the third Earl of Ashburnham, was born in London on April 5, 1837. He entered Balliol College, Oxford, in 1857, but left the university before graduating and went to Florence, where he made the acquaintance of Walter Savage Landor. His first published work, *The Queen-mother and Rosamond*, comprising two plays, appeared in 1861, but attracted little attention; but *Atalanta in Calydon* (1865), a tragedy of the classical type, dealing with a classical subject, was at once recognized as the work of a poet of no mean order. *Chastelard: A Tragedy*, treating of an incident in the career of Mary, Queen of Scots, was published later in the same year; and in 1866 he gained notoriety without adding to his reputation by the first series of *Poems and Ballads*. This volume was attacked on the score of indecency, and the publishers at once withdrew it from circulation. Mr. Swinburne made a scornful reply to his critics in *Notes on Poems and Reviews* (1866), and immediately afterwards re-issued the volume in an expurgated form through other publishers. The just indignation of the critics, however, it must now be admitted, obscured for the time the really great merits of some of the poems and ballads. *A Song of Italy* (1867) gave fine though somewhat obscure expression to his ardent political sympathies and hero-worship, and was succeeded by *Siena* (1868), another poem on an Italian subject. *An Ode on the Proclamation of the French Republic* (1870) prepared the way for his *Songs before Sunrise* (1871), in which a kind of pantheism and republicanism are set forth in melodious and skilfully-constructed verse. He returned to tragedy and *Mary Stuart in Bothwell* (1874), and in 1875 republished his *Song of Italy*. *Ode on the Proclamation of the French Republic*, and *Dirge* in a volume with the title *Songs of Two Nations*. *Erechtheus: A Tragedy* (1876), raised him, as one reviewer put it, from the rank of a fine poet to that of a great one, and his subsequent poems have, on the whole, greatly enhanced his reputation. These are, in order: *Poems and Ballads: Second Series* (1878); *Songs of the Springtides* (1880), consisting of three fine sea poems and a birthday ode to Victor Hugo; *Studies in Song* (1880); *Mary Stuart: a Tragedy* (1881), the last of his Scottish trilogy; *Tristram of Lyonesse*, and other *Poems* (1882), perhaps his finest volume, containing, in the title poem, one of his most perfect works; *A Century of Roundels* (1883); *A Midsummer Holiday*, and other *Poems* (1884); *Marino Faliero: A Tragedy* (1885); *Locrine: A Tragedy* (1887); *Poems and Ballads: Third Series* (1889); *The Sisters: A Tragedy* (1892); *Astrophel and other Poems* (1894); *A Tale of Balen* (1896); and *Rosamund, Queen of the Lombards: A Tragedy* (1899). Mr. Swinburne is not only a poet of high rank but also a fine critic, though his judgment is not always to be depended on. His prose style has many of the best qualities of his verse, and its charm is apt to make his studies appear more profound than they really are. His volumes of appreciations are the following: *William Blake: A Critical Essay* (1867); *Essays and Studies*

(1875); *George Chapman: A Critical Essay* (1875); *A Note on Charlotte Brontë* (1877); *A Study of Shakespeare* (1879); *Miscellanies* (1886); *A Study of Victor Hugo* (1886), a valuable work on his especial hero; *A Study of Ben Jonson* (1889); and *Studies in Prose and Poetry* (1894). A volume of selections from his poetical works was issued in 1887. Mr. Swinburne is unquestionably the greatest master of metres and of melody among poets of the Victorian era. He uses anapaestic and dactylic verses very frequently and with complete mastery, but the devices required to save such verses from uniformity and harshness, especially that of alliteration, often appear in his iambic and other metres, where they seem like mannerisms. Beauty of language is but too often the chief mark of his verse; in Mr. Courtney's words, he uses many adjectives and suggests few thoughts: 'Brilliantly gifted, profusely voluble, passionately rhetorical, he puts before us too often phrases instead of thoughts, verbal contortions instead of conceptions. . . he is not creative, not original in the best and largest sense of the word, because not instinct with illuminating ideas'. In 1871 he and D. G. Rossetti, who with William Morris have been called Pre-Raphaelite poets, were attacked by Robert Buchanan in an article on *The Fleshly School of Poetry*. Swinburne replied in *Under the Microscope* (1872). He also wrote a series of parodies under the title *The Modern Heptalogia* (1880); and in 1876 he issued a pamphlet against Gladstone. See the enthusiastic study by Wratislaw (1901); Courtney's *Studies New and Old* (1888); Lowell's *My Study Windows* (1871).

SWINE FEVER, or SWINE PLAGUE, is known as hog cholera in America, where it has caused enormous losses. It is a specific contagious fever, generally very rapid in its course, death ensuing in a very few days. To suppress the disease, all affected pigs, and if necessary those which have been in contact with them, must be killed, and the carcasses and litter burned or deeply buried. See *CONTAGIOUS DISEASES (ANIMALS) ACT*.

SWINTON, a town of England, in the West Riding of Yorkshire, 10 miles north-east of Sheffield. It is an industrial place, with pottery-works, glass-works, iron-works, coal-mines, railway-works, &c. Pop. (1891), 9705; (1901), 12,217.

SWINTON AND PENDLEBURY, a town of England, in Lancashire, about 4½ miles north-west of the centre of Manchester, with manufactures of cotton and other industries. Pop. (1891), 21,637; (1901), 27,001.

SYDNEY, a town of Canada, capital of Cape Breton county, Nova Scotia, on Cape Breton Island, on the south-west arm of Sydney harbour. It is a prosperous town and coaling station with an excellent harbour, and is connected by rail with North Sydney and other coal-mining centres. Steamers ply to Halifax (284 miles), North Sydney, Sydney Mines (both on Sydney harbour), and other ports. Pop. of Sydney in 1891, 2427, in 1901, 9909; of North Sydney (1891), 2522; (1901), 4646; of Sydney Mines (1891), 2446; (1901), 3191.

SYLHET. See SILHET.

SYLLABUS, a document issued by Pope Pius IX., Dec. 8, 1864, which condemned eighty current doctrines of the age as heresies. The syllabus reasserts all the claims of the mediæval papacy. It provoked conflicts between the papal and the civil power in Prussia, Austria, and Brazil.

SYLT, an island in the North Sea, off the coast of Schleswig-Holstein, to which province of Prussia it belongs; about 22 miles long, very narrow, but with a projecting peninsula on the east side; area, 40 square miles. It consists mainly of sand-dunes,

with some pasture for sheep. The inhabitants are mostly Frisians by origin, and are largely engaged in fishing. The island is also a sea-bathing centre. Pop. (1895), 2404.

**SYMONDS, JOHN ADDINGTON**, man of letters, son of a physician, was born at Bristol on Oct. 5, 1840. He was educated at Harrow, and in 1858 he went to Balliol College, Oxford, where he graduated with a first in classics. He gained the Newdigate prize for a poem on The Escorial in 1860, and the Chancellor's prize for an essay on The Renaissance in 1863. In 1862 he gained a fellowship at Magdalen College, which he vacated two years later on the occasion of his marriage. Not long afterwards a consumptive tendency declared itself, and most of his subsequent life was passed on the Continent, especially (from 1878) at Davos Platz, in Switzerland. He died in Rome on April 19, 1893, and is buried near Shelley. Symonds' chief work is his comprehensive history of The Renaissance in Italy, in seven volumes distributed thus: The Age of the Despots (1875; 2nd ed., 1880); The Revival of Learning (1877; new ed., 1882); The Fine Arts (1877; new ed., 1882); Italian Literature (two vols., 1881); The Catholic Reaction (two vols., 1886). An abridged edition of the whole was issued by Lieut.-Col. Pearson in 1893. This work is rather a series of monographs than a systematic history, but it shows throughout a thorough grasp of the subject, wide sympathies, and a broad outlook, and it is written in a style of much charm and eloquence. His other works are: Sketches in Italy and Greece (1874); Sketches and Studies in Italy (1879); and Italian Byways (1883), containing much admirable description; Introduction to the Study of Dante (1872; 2nd ed., 1890), and Studies of the Greek Poets (two series, 1873 and 1876), two excellent examples of critical appreciation; Many

Moods (1878), New and Old (1880), Animi Figures (1882), and Vagabunduli Libellus (1884), volumes of graceful and thoughtful but uninspired verse; lives of Shelley (1878), and Sir Philip Sidney (1886), in the series of English Men of Letters; Shakespeare's Predecessors (1884); Ben Jonson (1886); Essays, Speculative and Suggestive (two vols., 1890), and In the Key of Blue (1893); Our Life in the Swiss Highlands (1891), to which one of his daughters contributed; Life of Michelangelo Buonarroti (two vols., 1892); Walt Whitman: A Study (1893); Blank Verse (1894); and Giovanni Boccaccio, Man and Author (1894); besides contributions to the Encyclopædia Britannica. Symonds did some of his best work in translation from the Italian. His version of the Autobiography of Benvenuto Cellini (1887) is a masterpiece, and that of Count Carlo Gozzi's Autobiography (1890) is also notable. His translations of the sonnets of Michael Angelo and Campanella (1878) are almost perfect, and he was also extremely successful in his renderings of mediæval student-songs published under the title, Wine, Women, and Song (1884). See the excellent biography by H. F. Brown (1895).

**SYNDICATE**, a variety of the *trust* (which see in SUPP.), especially a less-developed form of trust.

**SYR-DARIA**. See **SIR-DARIA**.

**SZABADKA**. See **THERESIOPEL**.

**SZARVAS**, a town of Hungary, county of Békés, on the left bank of the Körös. It has a trade in cattle. Pop. (1890), 24,393; (1900), 25,773.

**SZEMAO**. See **SUMAO** in SUPP.

**SZIGETH**, or **SZIGETVAR**, a town of South-western Hungary, in the county of Somogy, on the river Almas, 120 miles s.s.w. of Budapest, formerly an important fortress. It is famous for its defence by Zrinyi in 1566 against a large Turkish force under Suleiman II. Pop. 5078.

## T.

**TAASINGE**, an island of Denmark, south of Funen; area, 29 square miles. The northern portion is hilly, but the south is flat, fertile, and wooded. Fruit is cultivated. Pop. 4340.

**TABES**, a term applied to a disease characterized by a gradually progressive emaciation of the whole body, accompanied with languor, depressed spirits, and, for the most part, imperfect or obscure hectic fever, without the real cause of the affection being properly localized or defined.—*Tabes mesenterica*,

abdominal phthisis, or consumption of the bowels, is a disease of the bowels caused by the formation of tubercles similar to those of the lungs in ordinary consumption. These are formed most abundantly in the neighbourhood of Peyer's glands. It causes extreme wasting, feebleness, and thinness of body, and recovery is rare. Treatment is of little avail, and is usually directed to maintaining the patient's general health.—*Tabes dorsalis* is the same as *locomotor ataxy* (which see in SUPP.).









